Populations in Ecosystems Pack 1

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Populations in Ecosystems Pack 1

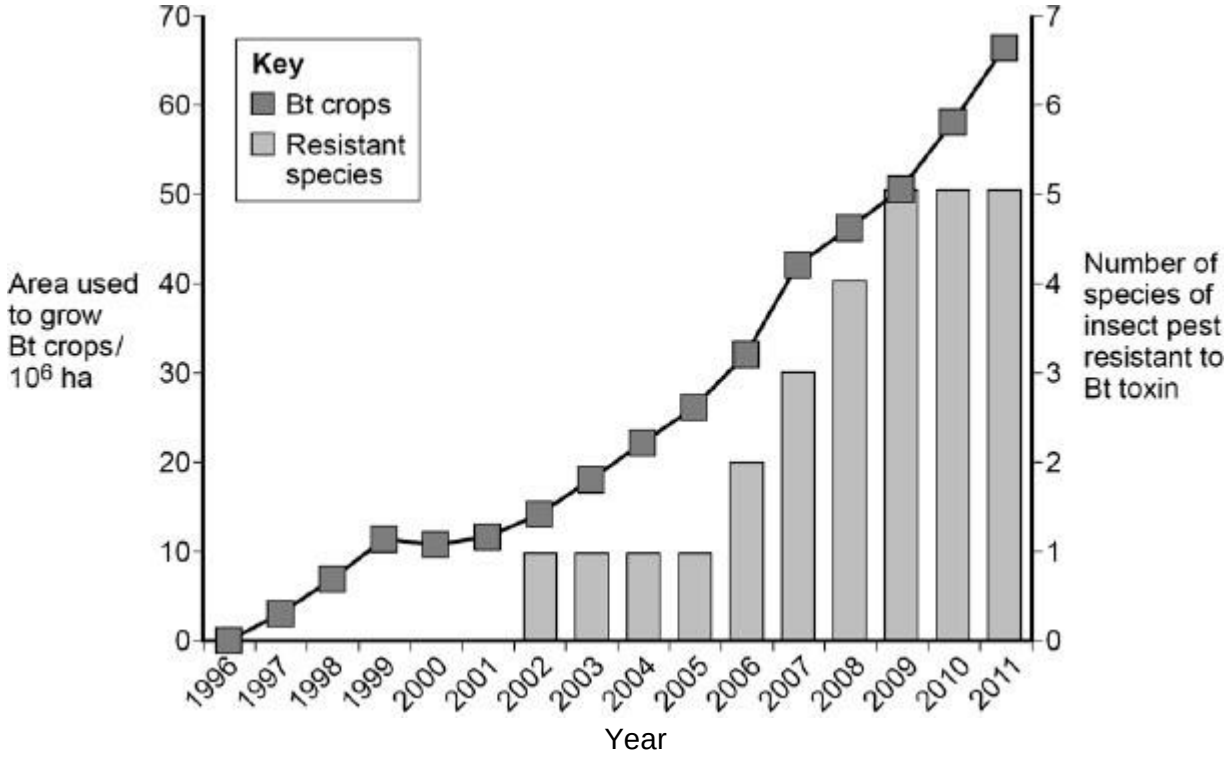
1 To reduce the damage caused by insect pests, some farmers spray their fields of crop plants with

pesticide. Many of these pesticides have been shown to cause environmental damage.

Bt plants have been genetically modified to produce a toxin that kills insect pests. The use of Bt crop plants has led to a reduction in the use of pesticides.

Scientists have found that some species of insect pest have become resistant to the toxin produced by the Bt crop plants.

The figure below shows information about the use of Bt crops and the number of species of insect pest resistant to the Bt toxin in one country.



(a) Can you conclude that the insect pest resistant to Bt toxin found in the years 2002 to 2005 was the same insect species? Explain your answer.

_____

_____

(1)

(b) One farmer stated that the increase in the use of Bt crop plants had caused a mutation inone of the insect species and that this mutation had spread to other species of insect. Was he correct? Explain your answer.

(Extra space) _____

(4)

(c) There was a time lag between the introduction of Bt crops and the appearance of the first insect species that was resistant to the Bt toxin. Explain why there was a time lag.

(3)

(Total 8 marks)

(a) What term is used to describe populations of different species living in the same habitat?

2

_____

(1)

(b) Different species occupy different ecological niches.

Explain the advantage of species occupying different niches.

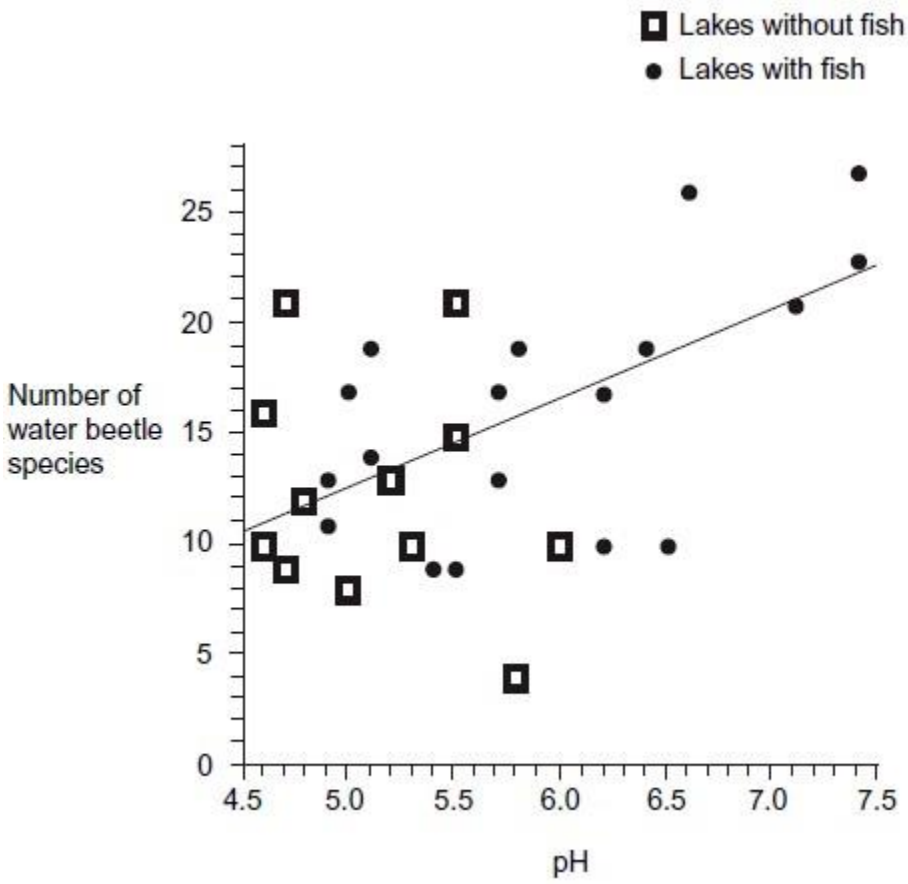
_____

_____

(1)

Scientists recorded the number of water beetle species in 30 lakes. In each lake, they measured the pH of the water and recorded whether there were any fish present.

The graph shows their results.



(c) A student concluded that a decrease in acidity caused an increase in the number of waterbeetle species.

Evaluate this conclusion.

_____

_____

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(3)

(d) Explain how the presence of fish in a lake could cause an increase in the number of waterbeetle species.

_____

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(1)

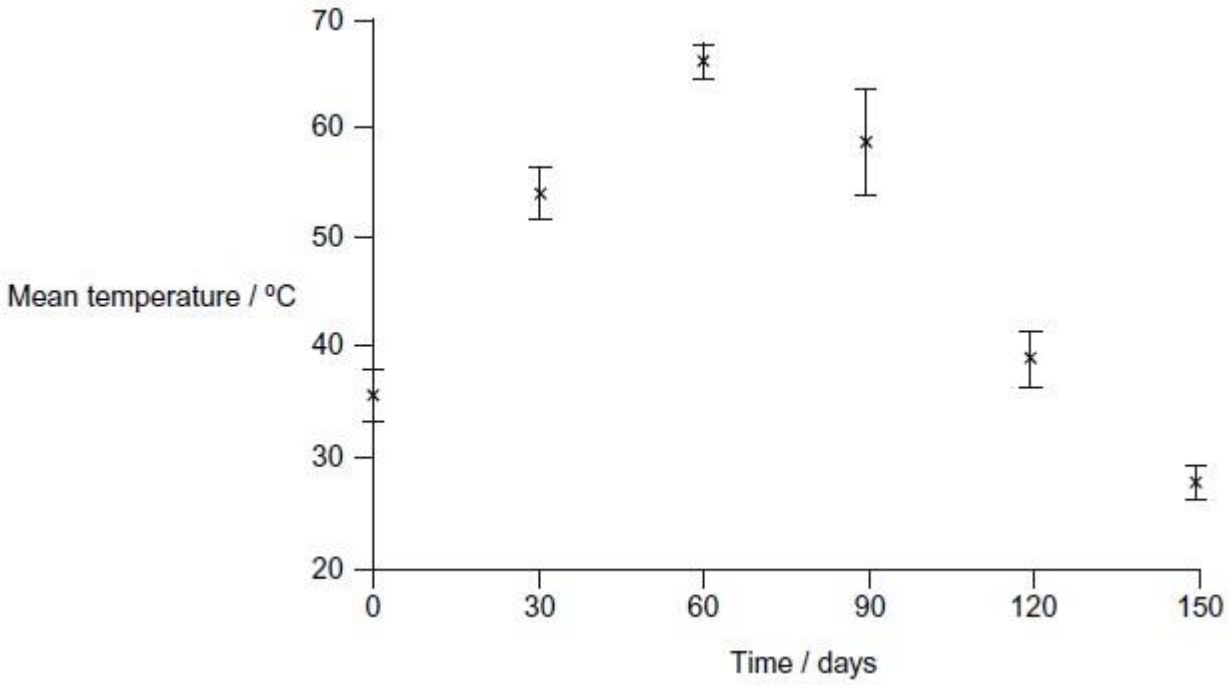
(Total 6 marks)

3 The organic material in household waste can be used to make compost for use as a fertiliser.

Scientists investigated changes during one process used to make this compost. The method involved placing the waste in large containers for 150 days. At regular intervals the containers were rotated. The scientists measured the temperature of samples of waste during the investigation.

Figure 1 shows the results they obtained. The vertical bars show standard deviations.

Figure 1



(a) Explain how microorganisms contributed to the increase in temperature during processingof organic waste.

_____

_____

_____

_____

(2)

(b) Explain the advantage of showing the data using standard deviations rather than ranges.

_____

_____

_____

_____

(2)

(c) Suggest **two** advantages of rotating the containers during the process.

1. _____

_____

2. _____

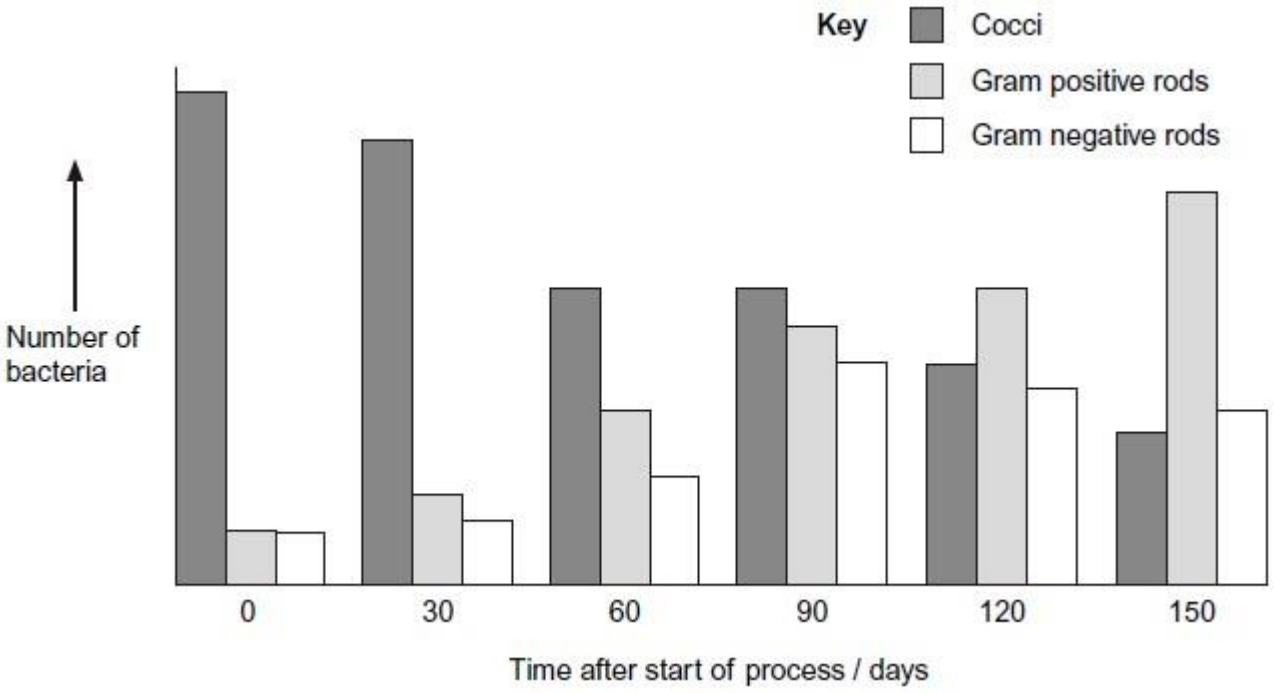
_____

(2)

(d) The scientists took a sample of the waste at the start of the process. They then took samples every 30 days. In each sample, they determined the numbers of particular types of bacteria.

Figure 2 shows the changes in the number of three types of bacteria during the process.

Figure 2



The scientists concluded that the results in **Figure 1** and **Figure 2** are evidence for a form of succession during the process.

Use the information to suggest how they reached this conclusion.

(3)

(Total 9 marks)

4 Algae are photosynthesising organisms. Some grow on rocky shores. Scientists investigated the abundance of different species of algae at two sites, **A** and **B**, on a rocky shore. Site **A** was on the upper shore and site **B** was on the lower shore. The diagram shows the location of sites **A** and **B** on the rocky shore.

Table 1 shows some of the results the scientists obtained.

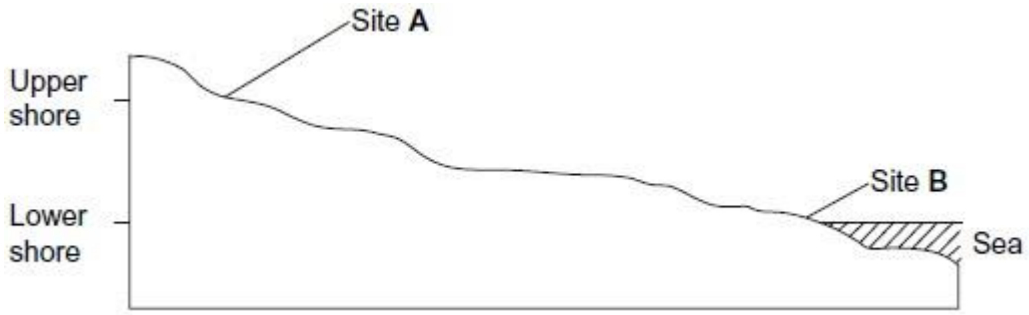


Table 1

	Site A **Upper shore**	**Site B** **Lower shore**
Species of algae with percentage cover more than 1%	*Gigartina leptorhynchos* *Gigartina canaliculata* *Gelidium coulteri* *Rhodoglossum affine*	*Gigartina spinosa* *Rhodoglossum affine* *Laurencia pacifica* *Gastroclonium coulteri* *Centroceros clavulatum* *Gigartina canaliculata* *Corallina vancouveriensis*

(a) The scientists recorded data from 40 large rocks at each site.

Describe **one** method that the scientists could have used to ensure that the large rocks were chosen without bias.

_____

_____

_____

_____

(2)

(b) The scientists used percentage cover rather than frequency to record the abundance ofalgae present

Suggest why.

_____

_____

(1)

(c) Apart from availability of water, describe and explain how **two** abiotic factors may have caused differences in the species of algae growing at sites **A** and **B**.

Factor 1 _____

Explanation _____

_____

Factor 2 _____

Explanation _____

_____

(2)

(d) Use the information provided in **Table 1** to explain why the diversity of consumers will be greater at site **B**.

_____

_____

_____

_____

(2)

(e) The scientists also investigated the algae eaten by two consumers found on the rockyshore, the sea slug and the shore crab. The scientists carried out their investigation in a laboratory.

- They put each consumer into a separate tank through which aerated seawater flowedslowly.
- Each tank contained 5 grams of one species of alga.
- After 50 hours, they measured the mass of the alga remaining in each tank.
- They repeated this procedure several times using a different sea slug and a differentshore crab each time.

The scientists then calculated the mean mass of each species of alga eaten by the consumers. They used a statistical test to determine the P value.

Table 2 shows some of the results they obtained.

Table 2

Species of alga	Mean mass eaten / g		P value
	Sea slug	Shore crab	
Laurencia pacifica	4.42	0.22	<0.01
Egregia leavigata	0.12	0.08	>0.05
Microcystis pyrifera	0.19	0.14	>0.05
Cystoseira osmondacea	0.17	0.04	<0.05

(i) The consumers were starved for 5 days before the investigation.

Explain why.

_____

_____

_____

_____

(2)

(ii) The data in **Table 2** for the mean mass of alga eaten were adjusted for loss of mass by the alga due to respiration.

Suggest how the scientists were able to determine the loss of mass due to respiration of a sample of alga.

_____

(3)

(iii) Suggest what conclusions the scientists could have made from this investigationwhen using the probability values in **Table 2**.

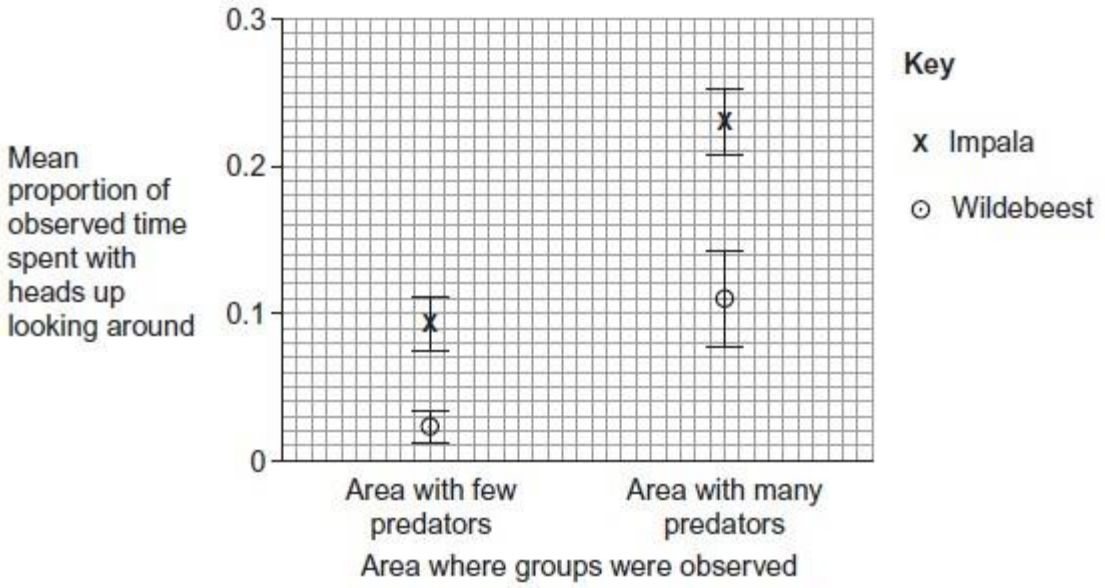
(3)

(Total 15 marks)

5 Impala and wildebeest are species of herbivore that live in large groups. They spend most of their time feeding with their heads near the ground.

Scientists investigated the relationship between the number of predators in an area and the mean proportion of time these herbivores spent with their heads up, looking around rather than feeding. They obtained data from groups of impala and wildebeest in two areas. In one area there were few predators and in the other area there were many predators.

The graph shows their results. The bars show standard deviations.



(a) The scientists observed both groups of animals for 75 hours.

Use data from the graph to calculate the difference in the mean number of hours spent by each species looking around in the area where there were **many** predators.

Show your working.

Difference _____ hours

(2)

(b) The scientists concluded that these herbivores spend more time looking for predators inareas where there are many predators.

Do these data support this conclusion? Give reasons for your answer.

_____

_____

_____

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(4)

(c) The behaviour of the herbivores in having their heads up has a benefit but it also has costs.The benefit is being able to see, and escape from, predators.

Suggest and explain **one** cost to the herbivores of this behaviour.

_____

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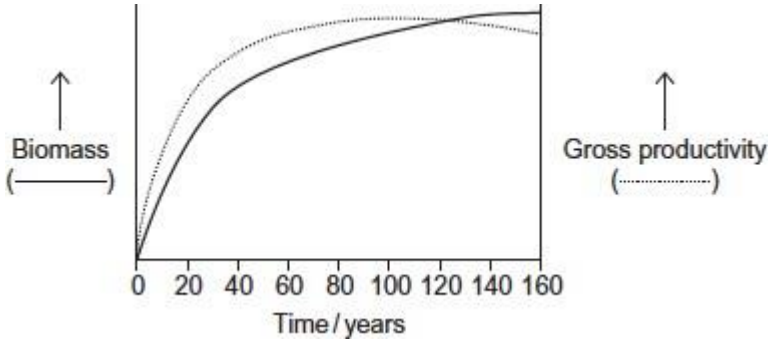
(2)

(Total 8 marks)

6 The graph shows how gross productivity and biomass in an area changed with time in the succession from bare soil to mature woodland.



(a) (i) Suggest appropriate units for gross productivity.

_____

(1)

(ii) Explain the decrease in gross productivity as the woodland matures.

(2)

(b) Use your knowledge of succession to explain the increase in biomass during the first 20 years.

[Extra space]

(3)

(c) Use the information in the graph and your knowledge of net productivity to explain whybiomass shows little increase after 100 years.

(2)

(d) Suggest **one** reason for conserving woodlands.

_____

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(1)

(Total 9 marks)

7 (a) On islands in the Caribbean, there are almost 150 species of lizards belonging to the genus

Anolis. Scientists believe that these species evolved from two species found on mainland USA. Explain how the Caribbean species could have evolved.

(6)

(b) *Anolis sagrei* is a species of lizard that is found on some of the smallest Caribbean islands. Describe how you could use the mark-release-recapture method to estimate the number of *Anolis sagrei* on one of these islands.

(4)

(c) Large areas of tropical forest are still found on some Caribbean islands. The concentrationof carbon dioxide in the air of these forests changes over a period of 24 hours and at different heights above ground.

Use your knowledge of photosynthesis and respiration to describe and explain how the concentration of carbon dioxide in the air changes:

- over a period of 24 hours
- at different heights above ground.

(5)

(Total 15 marks)

8 Hydrilla (*Hydrilla verticillata*) is an aquatic plant which has become a major pest of waterways in parts of the USA. Hydrilla is not a native species of the USA. It was introduced into natural habitats from aquariums. In many freshwater habitats it has rapidly become the dominant plant species.

(a) In many freshwater habitats Hydrilla has rapidly become the dominant plant species.Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(b) The spread of Hydrilla has had economic consequences for commercial activities and forthe government's environmental agency.
Suggest **two** economic consequences of the spread of Hydrilla.

1. _____

_____

2. _____

_____

(2)

(c) Scientists investigated the effect of the chemical fluridone as a method of controllingHydrilla. The study was carried out using samples of Hydrilla grown under controlled laboratory conditions. Several samples of the plant were grown at different concentrations of fluridone. The results are shown in the following table.

	Days of treatment			
	0	20	40	60
Concentration of fluridone / µg dm^{-3}	**Mean biomass of Hydrilla / g**			
0.0	5.0	16.4	20.4	33.4
0.5	5.0	14.1	18.2	31.3
1.0	5.0	9.7	8.9	7.4
5.0	5.0	4.6	2.8	1.3
25.0	5.0	3.2	1.6	0.4

(i) The scientists obtained the biomass of each sample by heating it at 75 °C for 2 hours.They then weighed the sample, reheated it for 15 minutes and weighed it

again. They continued this cycle of reheating and weighing until they found the sample had a constant mass.

Explain how this method helped to provide a reliable measurement of the biomass.

(2)

(ii) A scientist reviewed the results of this investigation. He suggested that fluridoneshould be used in the habitat at a concentration of 5.0 µg dm^{-3} rather than at the other concentrations tested. Use the information provided and your knowledge of chemical control to explain why he made this suggestion.

(Extra space)

(4)

(d) Scientists have also investigated the use of an integrated system to control Hydrilla. This involved using fluridone and a fungus as a biological control agent. They set up four different experiments.

- Experiment **1** – Hydrilla left untreated
- Experiment **2** – Hydrilla treated with the fungus
- Experiment **3** – Hydrilla treated with fluridone
- Experiment **4** – Hydrilla treated with both fluridone and the fungus.

The scientists determined the biomass of Hydrilla at the end of each experiment.

(i) Experiment **1** acted as a control. Explain why the scientists carried out experiment **1**.

_____

_____

(1)

(ii) The scientists isolated the fungus from the tissue of Hydrilla growing in its country oforigin. Suggest **two** possible advantages of using this fungus as the biological control agent.

1. _____

_____

2. _____

_____

(2)

(iii) The treatment in experiment **4** was the most effective. Use your knowledge of integrated pest control systems to suggest why the treatment in experiment **4** was the most effective.

_____

_____

_____

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(Extra space) _____

_____

(2)

(Total 15 marks)

9 Ecologists used a method called proportional sampling to estimate the population size of an animal species. This method is based on assumptions. Two of the assumptions are given below.

1. They know the size of the area, **A**, where the animal population lives.
2. The animals are uniformly distributed in this area.

To carry out the method, the ecologists:

- chose a region of known size, **R**, inside area **A**
- counted the number of animals in region **R**. They called this number **S**
- assumed that the number, **S**, would be in proportion to the size of the total population, **P**, in area **A**.

(a) Proportional sampling can be used to estimate the population size of a species that isuniformly distributed.

(i) What is a **species**?

_____

_____

_____

(1)

(ii) What is meant by **uniformly distributed**?

_____

_____

_____

(1)

(b) Use the letters **A**, **R** and **S** to write an equation showing how proportional sampling is used to estimate the total size of a population, **P**. Show your working.

P = _____

(2)

(c) Population size can be estimated using proportional sampling or mark-release-recapture.

(i) How do the assumptions made in proportional sampling differ from those made inmark-release-recapture?

_____

_____

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_____

_____

(2)

(ii) Give **one** assumption about the animals caught that is made in both methods.

_____

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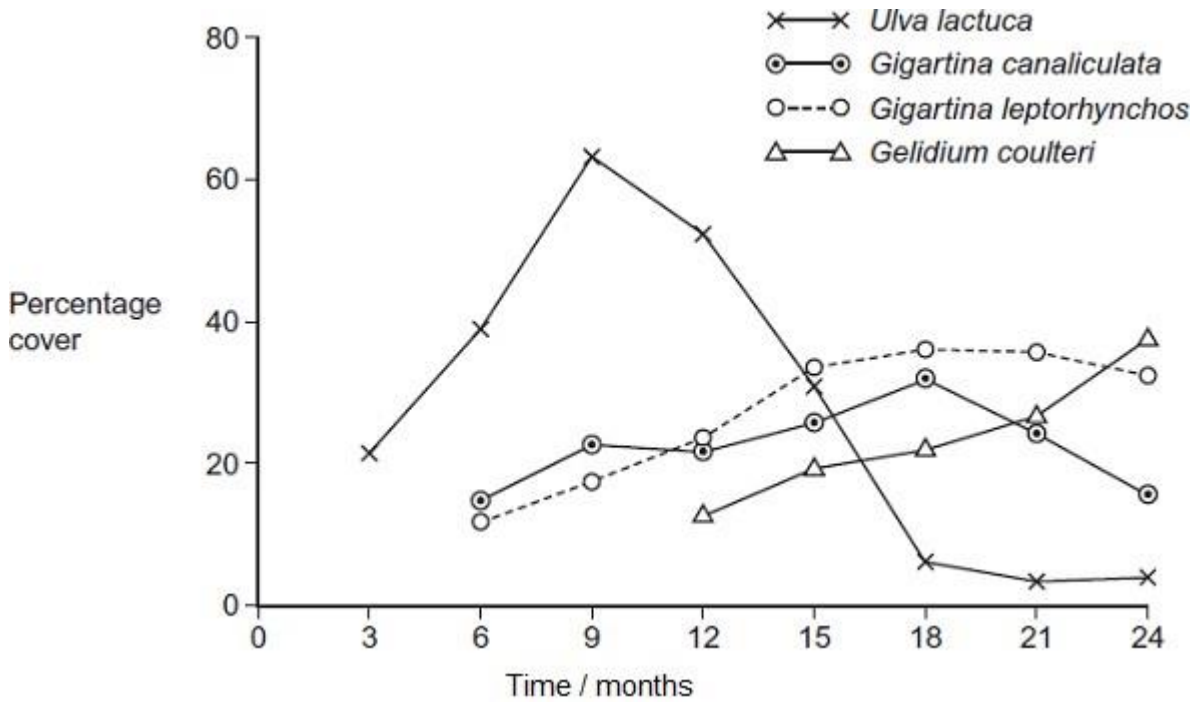
_____

(1)

(Total 7 marks)

10 Algae are photosynthesising organisms. Some algae grow on rocky shores. A scientist investigated succession involving different species of algae. He placed concrete blocks on a rocky shore. At regular intervals over 2 years, he recorded the percentage cover of algal species on the blocks. His results are shown in the graph.



(a) Name the pioneer species.

_____

(1)

(b) (i) The scientist used percentage cover rather than frequency to record the abundance ofalgae present. Suggest why.

_____

_____

_____

(1)

(ii) Some scientists reviewing this investigation were concerned about the validity of the results because of the use of concrete blocks.
Suggest **one** reason why these scientists were concerned about using concrete blocks for the growth of algae.

(1)

(c) Use the results of this investigation to describe and explain the process of succession.

(Extra space)

(4)

(Total 7 marks)

Essay

11

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy. It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is

Scientific 16

Breadth of knowledge	3
Relevance	3
Quality of written communication	3

Write an essay on the following topic:

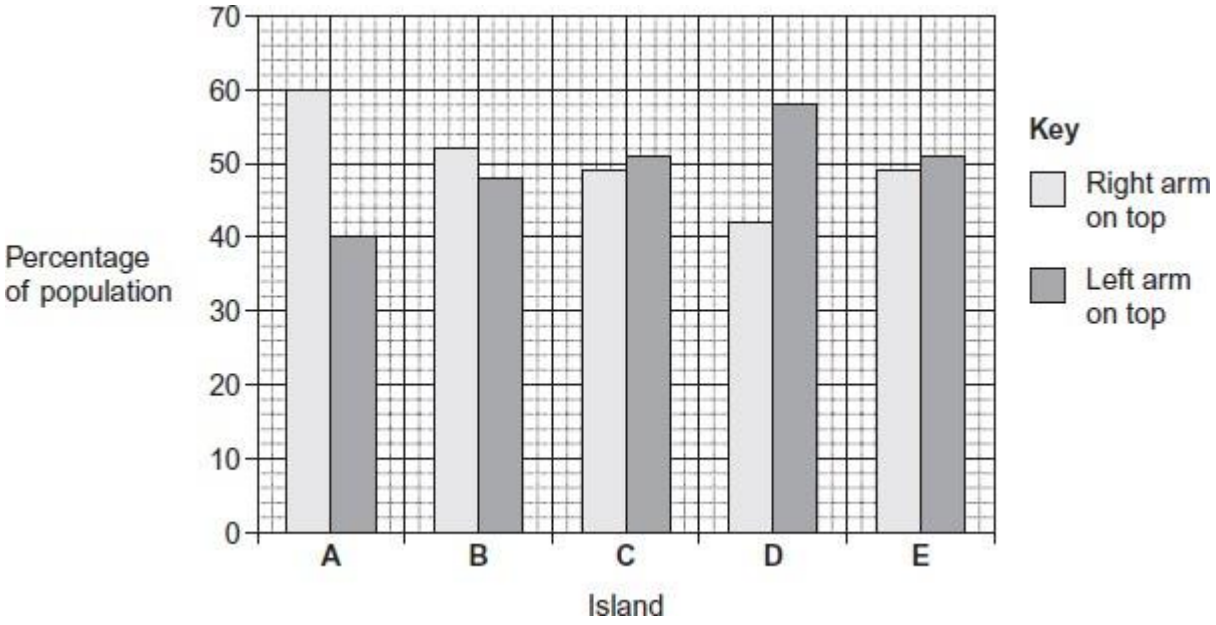
There are many different types of relationships and interactions between organisms.

(Total 25 marks)

12 When most people fold their arms, they either always have their left arm on top, **L**, or always have their right arm on top, **R**. A geneticist investigated this characteristic on five small islands, **A, B, C, D** and **E**.

Her results are shown in **Figure 1**.

Figure 1



On one of the islands she recorded the arm-folding characteristics of parents and their children.

These results are shown in **Figure 2**.

Figure 2

Arm-folding of parents	Arm-folding of the children / %	
	Right arm on top, R	Left arm on top, L
R and **R**	41	59
R and **L**	45	55
L and **L**	44	56

The geneticist concluded that arm-folding is not determined by a single gene with a dominant allele and a recessive allele.

(a) The geneticist investigated arm-folding on five small islands.

(i) Use information from **Figure 1** to describe the results she obtained.

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_____

_____

_____

(2)

(ii) Suggest advantages of using island populations in this investigation.

_____

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_____

_____

_____

(2)

(b) The geneticist concluded that arm-folding is **not** determined by a single gene with a dominant allele and a recessive allele.

Use information from **Figure 2** to explain why she reached this conclusion.

(Extra space)

(3)

(c) In another study, the geneticist investigated arm-folding in genetically identical twins. Data from this study supported her conclusion from the island study.

Suggest the evidence she found that supported her conclusion.

(1)

(Total 8 marks)

13 A student investigated an area of moorland where succession was occurring. She used quadrats to measure the percentage cover of plant species, bare ground and surface water every 10 metres along a transect. She also recorded the depth of soil at each quadrat. Her results are shown in the table.

	Percentage cover in each quadrat A to E				
	A	**B**	**C**	**D**	**E**

Bog moss	55	40	10	–	–
Bell heather	–	–	–	15	10
Sundew	10	5	–	–	–
Ling	–	–	–	15	20
Bilberry	–	–	–	15	25
Heath grass	–	–	30	10	5
Soft rush	–	30	20	5	5
Sheep's fescue	–	–	25	35	30
Bare ground	20	15	10	5	5
Surface water	15	10	5	–	–
Soil depth / cm	3.2	4.7	8.2	11.5	14.8

– Indicates zero percentage cover.

(a) Explain how these data suggest that succession has occurred from points **A** to **E** along the transect.

_____

_____

_____

_____

_____

_____

*(Extra space)*_____

_____

_____

(3)

(b) The diversity of animal species is higher at **E** than **A**. Explain why.

_____

_____

_____

_____

_____

(2)

(c) The student used the mark-release-recapture technique to estimate the size of thepopulation of sand lizards on an area of moorland. She collected 17 lizards and marked them before releasing them back into the same area. Later, she collected 20 lizards, 10 of which were marked.

(i) Give **two** conditions for results from mark-release-recapture investigations to be valid.

1. _____

_____

2. _____

_____

(2)

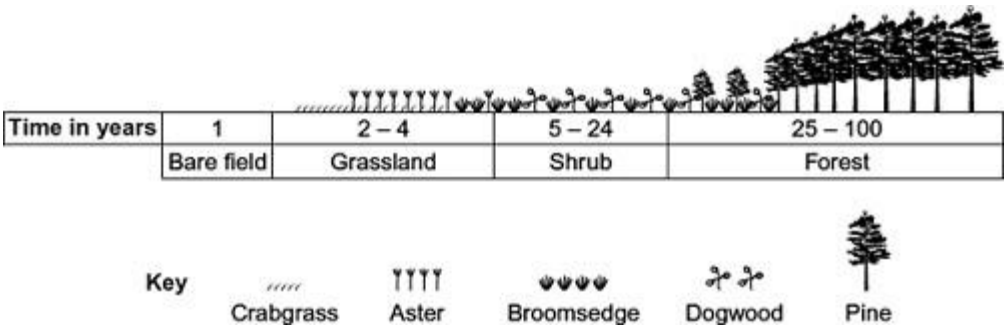
(ii) Calculate the number of sand lizards on this area of moorland. Show your working.

Answer = _____

(2)

(Total 9 marks)

14 The diagram shows the dominant plants in communities formed during a succession from bare soil to pine forest.



(a) Name the pioneer species shown in the diagram.

_____

(1)

(b) The species that are present change during succession. Explain why.

_____

_____

_____

_____

_____

(2)

(c) The pine trees in the forest have leaves all year. Explain how this results in a low speciesdiversity of plants in the forest.

_____

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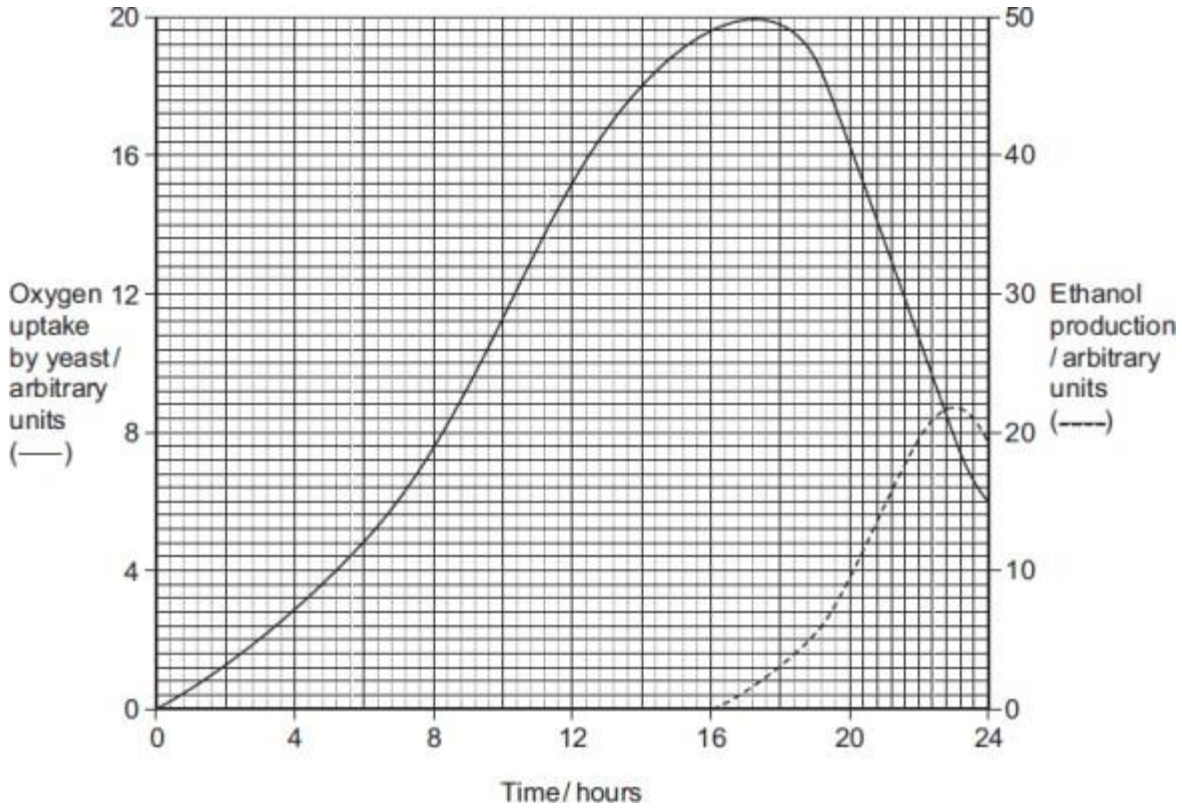
(1)

(Total 4 marks)

15 Yeast is a single-celled organism. A student investigated respiration in a population of yeast growing in a sealed container. His results are shown in the graph.



(a) Calculate the rate of oxygen uptake in arbitrary units per hour between 2 and 4 hours.

Answer _____ arbitrary units per hour

(1)

(b) (i) Use the information provided to explain the changes in oxygen uptake during thisinvestigation.

_____

_____

_____

_____

_____

(Extra space)

(3)

(ii) Use the information provided to explain the changes in production of ethanol during this investigation.

(2)

(c) Sodium azide is a substance that inhibits the electron transport chain in respiration.Thestudent repeated the investigation but added sodium azide after 4 hours. Suggest and explain how the addition of sodium azide would affect oxygen uptake and the production of ethanol.

(Extra space)

(3)

(Total 9 marks) (a) Explain what is meant by the ecological term community

16

_____

_____

_____

_____

(1)

(b) Scientists investigated the distribution of three species of fish in a lake. They recorded therange of depths where each species was found. The table shows their results.

Species of fish	Range of depths /m
White bass	0 to 8.4
Walleye	6.8 to 10.0
Sauger	7.2 to 14.6

(i) Use information from the table to give the range of depths at which all three speciesof fish may be found living together.

Answer _____ m

(1)

(ii) Suggest and explain **one** advantage to the fish of occupying different depths in the lake.

_____

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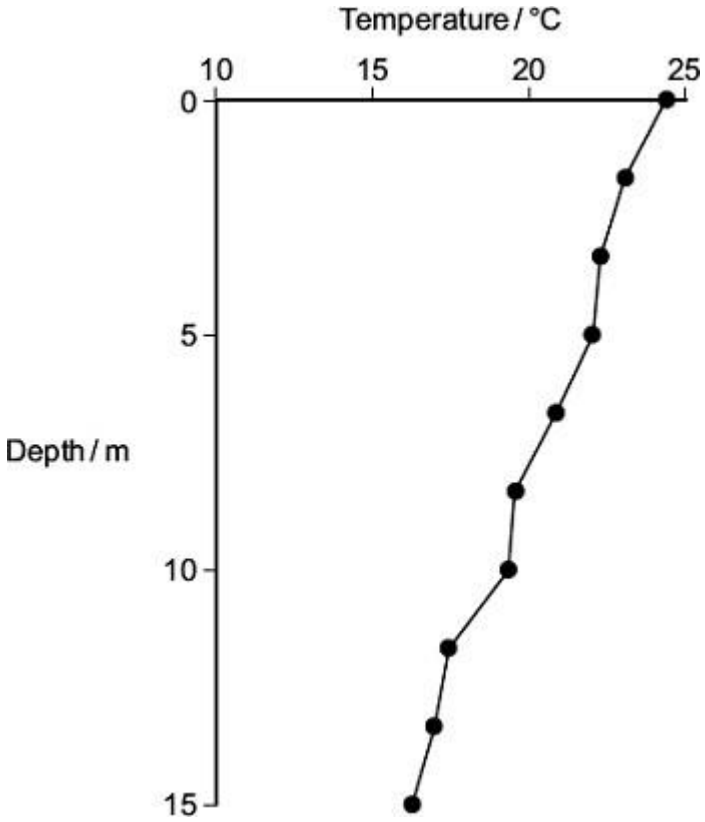
_____

(2)

(c) The graph shows the relationship between the depth and the temperature of the water inthe lake.



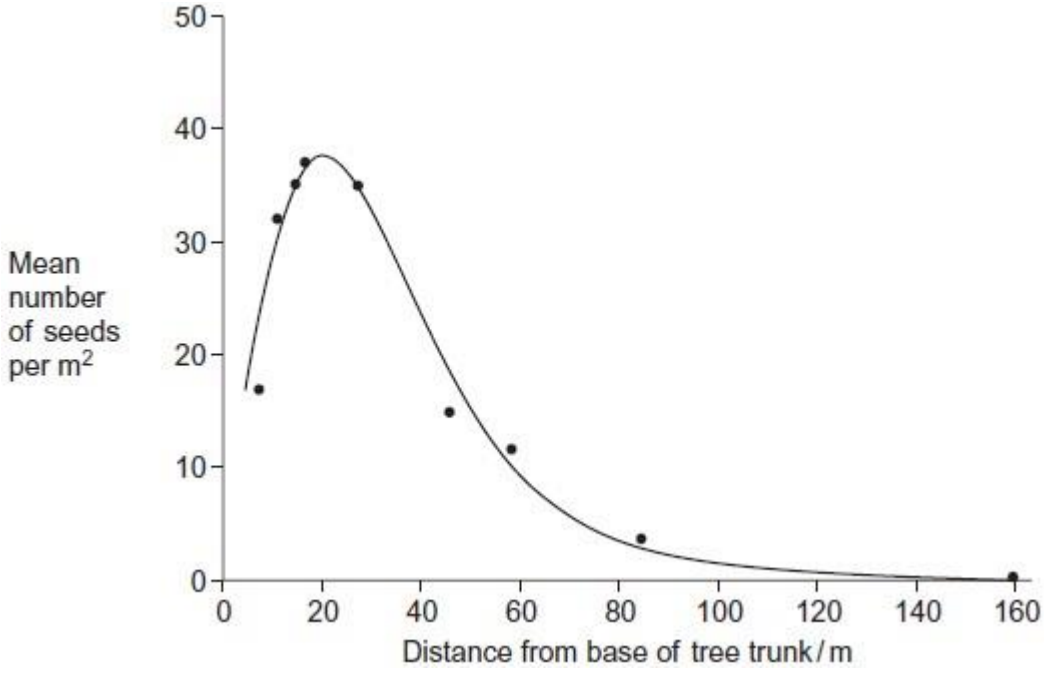
A student concluded that the temperature of the water in the lake determined the depth at which the species of fish were found. Use the table and the graph to evaluate this conclusion.

(Extra space)

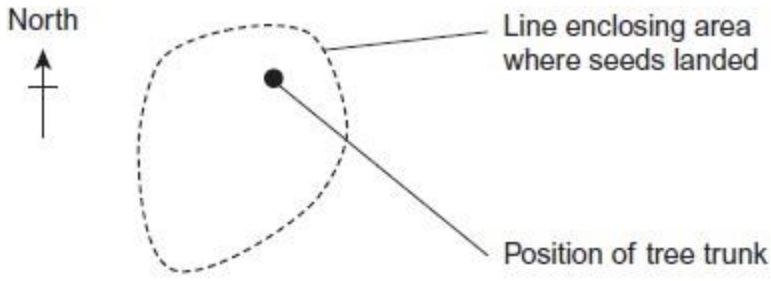
(3)

(Total 7 marks)

17 A 75 m tall tree released very large numbers of small seeds. Ecologists used quadrats along a transect to measure the number of these seeds at different distances from the tree. Their results are shown on the graph.



The seeds of this tree are dispersed by wind. The diagram shows the pattern of seed dispersal from this tree.



(a) Describe how the ecologists could have used quadrats and a transect to obtain the datafrom which the graph was drawn.

_____

_____

_____

_____

_____

(2)

(b) Look at the diagram showing the pattern of seed dispersal from this tree.

(i) Suggest an explanation for the shape of the line enclosing the area where the seedslanded.

_____

_____

_____

_____

(2)

(ii) The line enclosing the area where the seeds landed would be different for trees of thisspecies that were of a different height. Suggest why.

_____

_____

_____

_____

(2)

(c) In an ecological succession, trees that are pioneer species often have smaller seeds thanthose that are part of a climax community.

(i) The species of tree in this investigation is adapted to colonising areas that have beencleared of vegetation. Use information given above to explain how.

_____

_____

_____

_____

(2)

(ii) The seeds produced by this species of tree did **not** grow successfully in a climax community. Suggest why.

_____

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_____

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(2)

(Total 10 marks)

18 Agricultural scientists divided a field into a number of different plots. They planted soya bean seeds in these plots at different sowing densities. The diagram shows how these plots were arranged. The numbers show the sowing densities in seeds per m^2. The plots containing seeds sown at a density of 250 seeds per m^2 have been shaded.

250	500	1000	15	25	50	100
15	25	50	100	250	500	1000
25	50	100	250	500	1000	15
50	100	250	500	1000	15	25
1000	15	25	50	100	250	500
500	1000	15	25	50	100	250
100	250	500	1000	15	25	50

The scientists recorded the number of soya bean plants growing in each plot at different times after the start of the investigation. Their results are shown in the table.

Number of seeds planted per m^2	Mean number of plants surviving per m^2 after

	22 days	39 days	61 days	93 days
15	15	15	15	15
25	24	24	24	23
50	47	46	46	41
100	98	96	96	87
250	246	242	204	196
500	492	486	313	124
1000	987	788	276	95

(a) (i) In terms of rows and columns, describe how the plots containing seeds sown at a density of 250 m^2 were arranged.

_____

_____

(1)

(ii) Explain the advantage of arranging the plots in this way.

_____

_____

_____

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(2)

(b) The scientists would have treated the plots in the same way. Suggest **two** ways in which the scientists would have treated the plots to ensure that confounding variables would **not** affect the results.

1. _____

_____

2. _____

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(2)

(c) (i) Describe the results of this investigation.

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(Extra space)_____

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(3)

(ii) Explain the results when 1000 seeds were planted per m^2.

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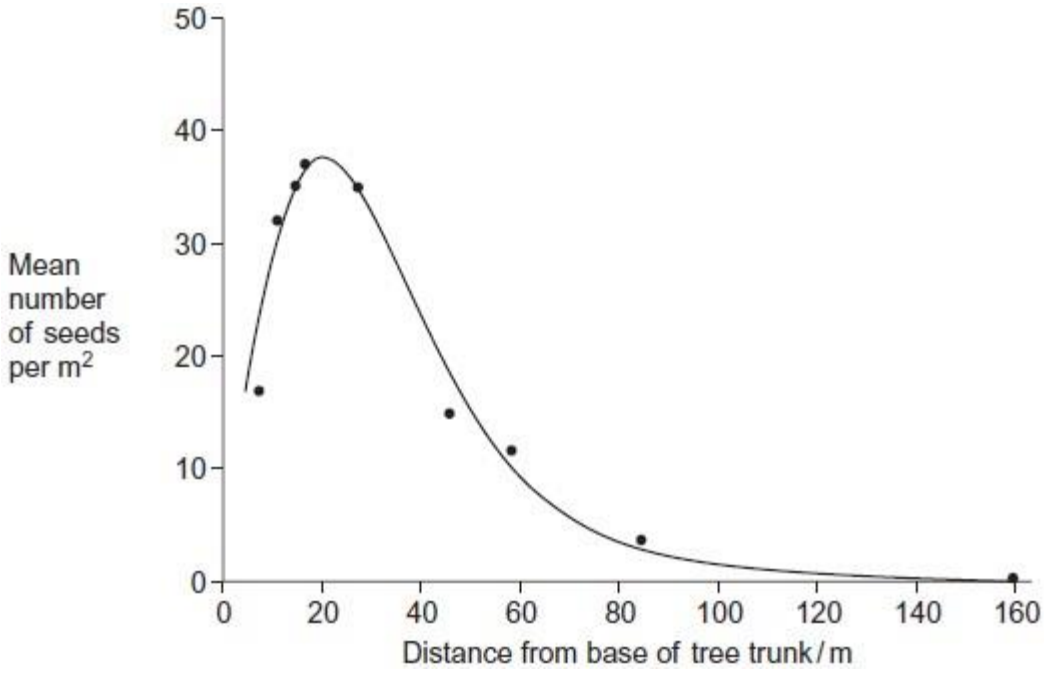
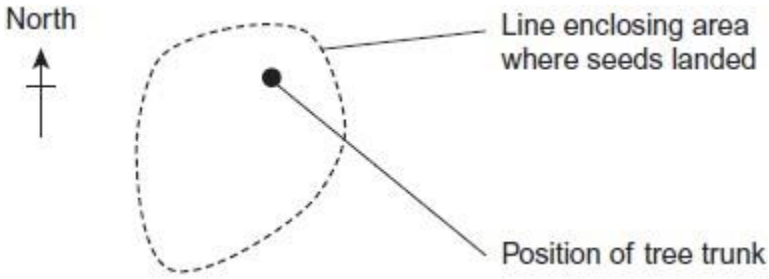
(2)

(Total 10 marks)

19 A 75 m tall tree released very large numbers of small seeds. Ecologists used quadrats along a transect to measure the number of these seeds at different distances from the tree. Their results are shown on the graph.



The seeds of this tree are dispersed by wind. The diagram shows the pattern of seed dispersal from this tree.



Agricultural scientists divided a field into a number of different plots. They planted soya bean seeds in these plots at different sowing densities. The diagram shows how these plots were arranged. The numbers show the sowing densities in seeds per m^2. The plots containing seeds sown at a density of 250 seeds per m^2 have been shaded.

250	500	1000	15	25	50	100
15	25	50	100	250	500	1000
25	50	100	250	500	1000	15

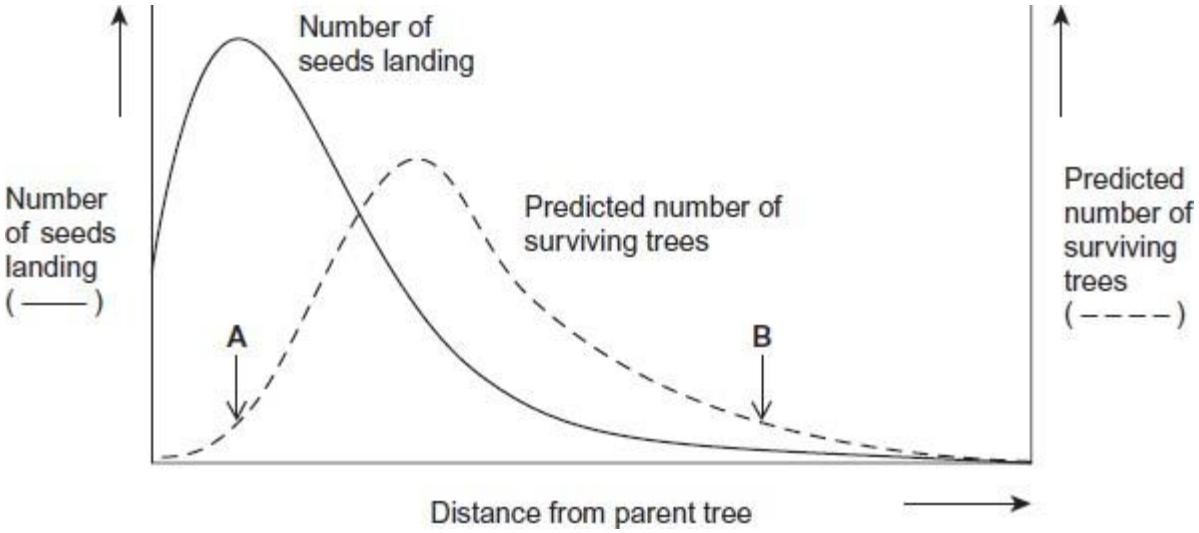
50	100	250	500	1000	15	25
1000	15	25	50	100	250	500
500	1000	15	25	50	100	250
100	250	500	1000	15	25	50

The scientists recorded the number of soya bean plants growing in each plot at different times after the start of the investigation. Their results are shown in the table.

Number of seeds planted per m^2	**Mean number of plants surviving per m^2 after**			
	22 days	**39 days**	**61 days**	**93 days**
15	15	15	15	15
25	24	24	24	23
50	47	46	46	41
100	98	96	96	87
250	246	242	204	196
500	492	486	313	124
1000	987	788	276	95

(a) A scientist measured the number of seeds landing at different distances from a parent tree. He then produced a theoretical model. He used this model to predict how the number of new trees that grew from the seeds and survived varied with distance from the parent tree. The scales used for the two vertical axes are different.

The predictions from this model are summarised in the graph.



(i) Explain why the model predicts a low number of surviving trees at point **A**

(Extra space)

(3)

(ii) Explain why the model predicts a low number of surviving trees at point **B**.

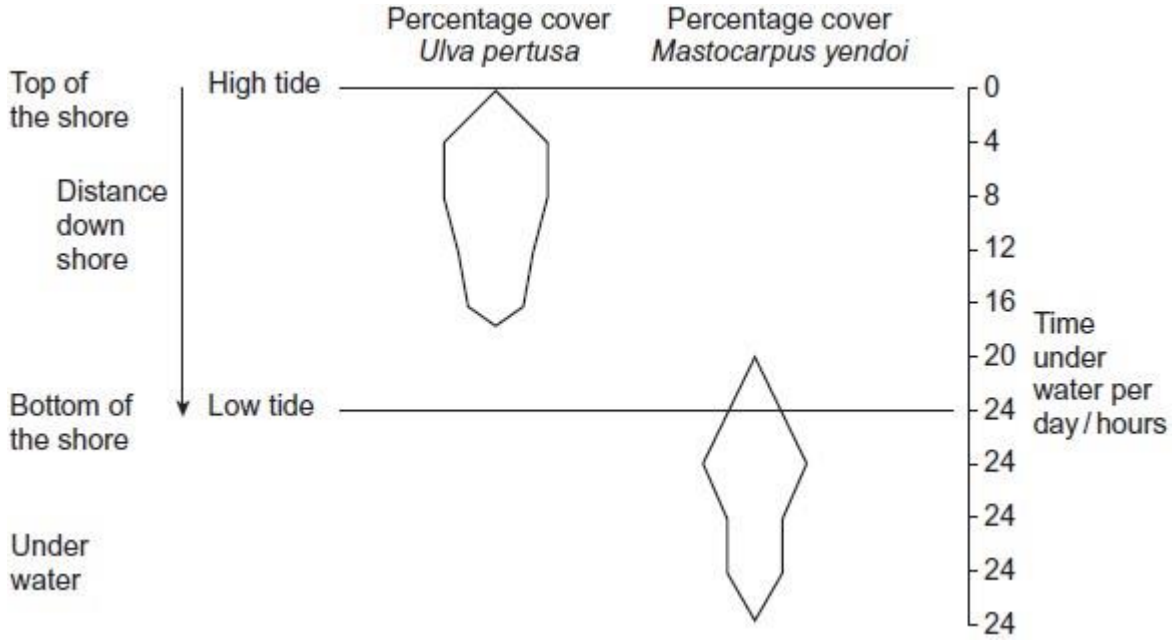
(2)

(Total 5 marks)

20 Rocky shores are covered and uncovered by sea water as the tide moves in and out during the day.

An ecologist visited a rocky shore during low tide (when the shore was not covered by sea water).
He investigated the distribution of the two species of seaweed.

The ecologist estimated the percentage cover of each of the seaweeds at various positions on the seashore. He also recorded the mean length of time during the day for which each sampled area was covered by sea water caused by the rising tide. He used the kite diagram below to show his results. The width of each kite at any point is proportional to the percentage cover of a seaweed.



(a) Describe how the ecologist would have collected the data to draw the kite diagram for *U. pertusa* in the figure.

_____

_____

_____

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(Extra space)

(3)

(b) *U. pertusa* has thicker cell walls than *M. yendoi*. Use this information, in addition to the information from the diagram above, to suggest reasons for the difference in distribution of the two species of seaweed.

(Extra space)

(3)

(Total 6 marks)

21 Ecologists studied a community of fish in a lake.

(a) Explain what is meant by a community.

(1)

(b) (i) The ecologists could have used the mark-release-recapture method to estimate thenumber of one species of fish in the lake. Describe how.

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*(Extra space)*_____

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(3)

(ii) This species of fish breeds at a certain time of the year. During this fish-breeding season, the mark-release-recapture technique might **not** give a reliable estimate. Suggest **one** reason why.

_____

_____

_____

(1)

(c) The ecologists found that each species of fish had adaptations to its niche. One of theseadaptations was the shape of its mouth.

Suggest how the shape of mouth is an adaptation to its niche.

_____

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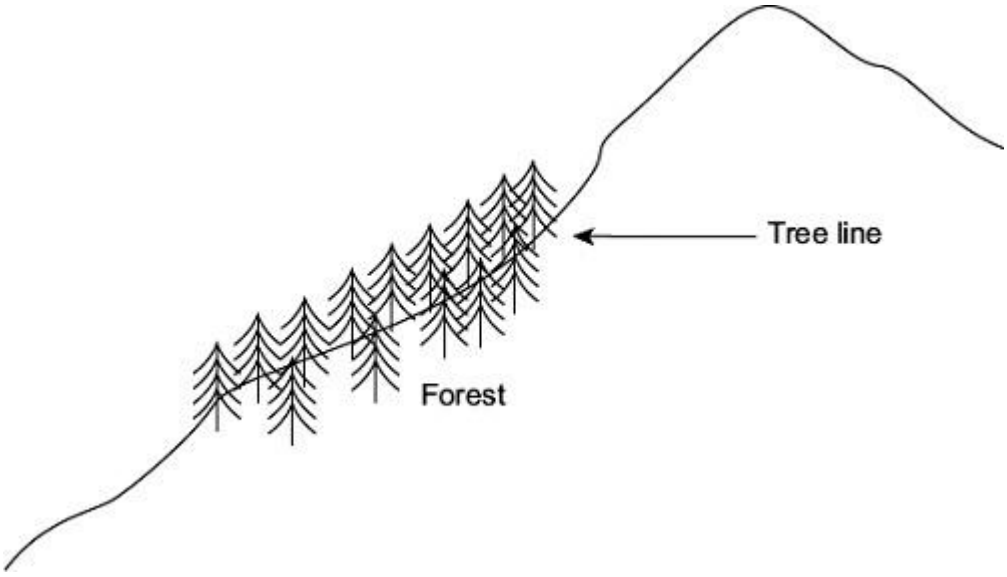
(2)

22 Mountains are harsh environments. The higher up the mountain, the lower the temperature becomes. The diagram shows a forest growing on the side of a mountain.
The upper boundary of the forest is called the tree line. Trees do not grow above the tree line.



(a) (i) The position of the tree line is determined by abiotic factors.What is meant by an abiotic factor?

_____

_____

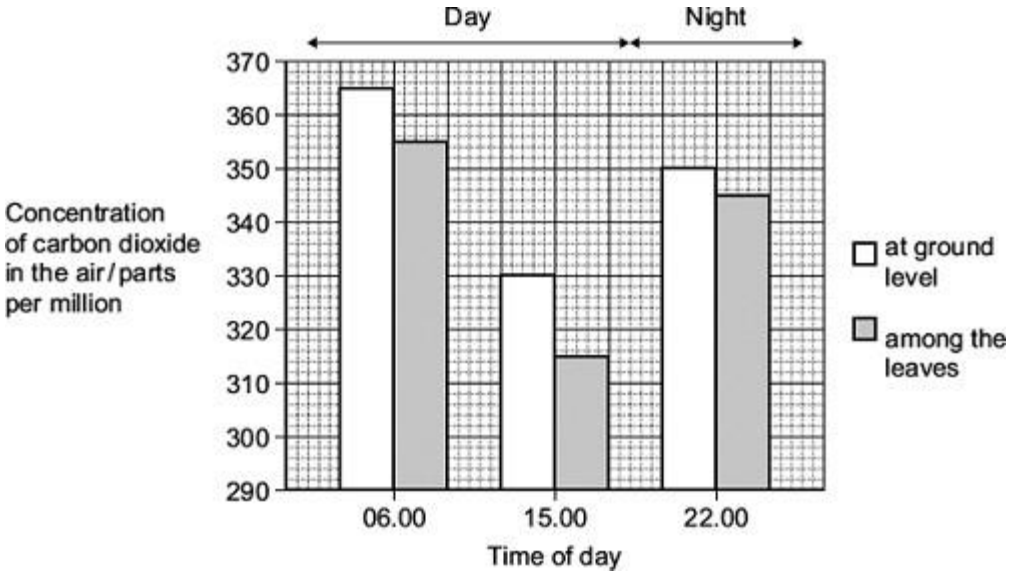
(1)

(ii) Other than temperature, suggest **one** abiotic factor that is likely to affect the position of the tree line on the mountain.

_____

(1)

(b) Scientists measured the concentration of carbon dioxide in the air in one part of the forest.They took measurements at different times of day and at two different heights above the ground. Their results are shown in the bar chart.



Use your knowledge of photosynthesis and respiration to explain the data in the bar chart.

(Extra space)

(4)

(c) The population of trees in the forest evolved adaptations to the mountain environment. Use your knowledge of selection to explain how.

(Extra space)

(3)

(Total 9 marks)

23 The photograph shows marram grass growing on a sand dune.

Marram grass on sand dune by Nigel Chadwick [CC-BY-SA], via Wikimedia Commons

(a) Describe how you would investigate the distribution of marram grass from oneside of the dune to the other.

_____

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*(Extra space)*_____

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(3)

(b) Marram grass is a pioneer species that grows on sand dunes. It has long rootsand a vertically growing stem that grows up through the sand.
Sand dunes are easily damaged by visitors and are blown by the wind. Planting marram grass is useful in helping sand dune ecosystems to recover from damage.

Use your knowledge of succession to explain how.

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(2)

(Total 5 marks)

24 Parasites are organisms that live on or in host organisms. The populations of many organisms may be reduced by the effects of parasites.

Feather mites are small parasites found on the wing feathers of many birds. The mites feed on the oil that the birds produce. This oil keeps the feathers in good condition. Birds unable to oil their feathers properly use more energy in maintaining their body temperature. This results in less energy being available for other processes.

Scientists investigated the relationship between the numbers of feather mites and the breeding success of one species of bird, the great tit.

(a) Use the information above to suggest how feather mites could affect breeding in great tits.

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(2)

(b) The scientists located a large number of great tit nests. They sampled these at random.

For each nest they recorded

- the total number of eggs laid
- the number of chicks that hatched from the eggs
- the number of chicks that survived to leave the nest

- the total number of feather mites on the two parent birds.

(i) Explain why the scientists sampled the nests at random.

_____

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(2)

(ii) The scientists calculated the percentage of each pair's eggs from which chickssurvived to leave the nest. They called this 'breeding success per pair'.

The table shows some of the data that the scientists obtained.

Total number of feather mites on both parent birds	Breeding success per pair
0	86
2	100
5	64
10	82
14	70
15	85
170	42

Do these data support the hypothesis that the presence of feather mites reduces the ability of great tits to reproduce successfully? Give reasons for your answer.

_____

_____

_____

_____

(*Extra Space*)

(3)

(c) The scientists calculated a correlation coefficient for these data.

(i) State a null hypothesis that would be appropriate for this investigation.

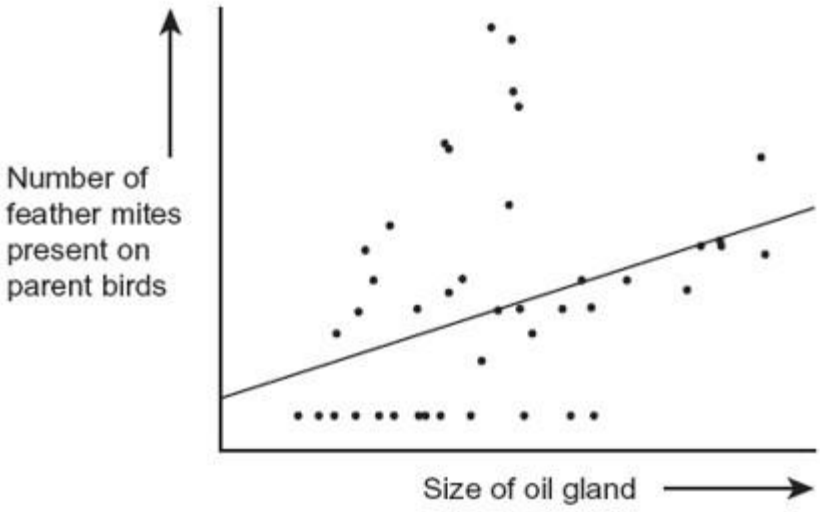
(1)

(ii) The correlation coefficient that they obtained had a negative value. What does anegative value indicate about these data?

(1)

(d) The oil that a great tit puts on its feathers is made in an oil gland at the base of the tail. Thebird uses its beak to spread the oil over its feathers. This is called preening. Preening takes place in early morning and evening and empties the oil gland each time. After preening, the oil gland is considerably smaller.

At the same time that the scientists recorded the number of feather mites on each great tit, they also measured the size of the oil gland. The graph shows their results and includes the scientist's line of best fit.



(i) Describe the relationship between the number of feather mites present on each greattit and the size of the oil gland.

(2)

(ii) Explain how measuring the oil gland at the same time as counting the feather mitesmay have affected the reliability of the data.

(2)

(e) Feather mites eat pathogenic bacteria and fungi as well as oil. Explain how this may affectthe breeding success of the birds.

(2)

(Total 15 marks)

25 Herbicides are substances that kill weeds. Three farmers wanted to know which herbicide to use to control weeds in fields of barley. They chose eleven fields of barley and used a different herbicide in each field. Four weeks later they collected, counted and weighed the weeds in each field. Their results are shown in **Figure 1** and **Figure 2**.

Figure 1

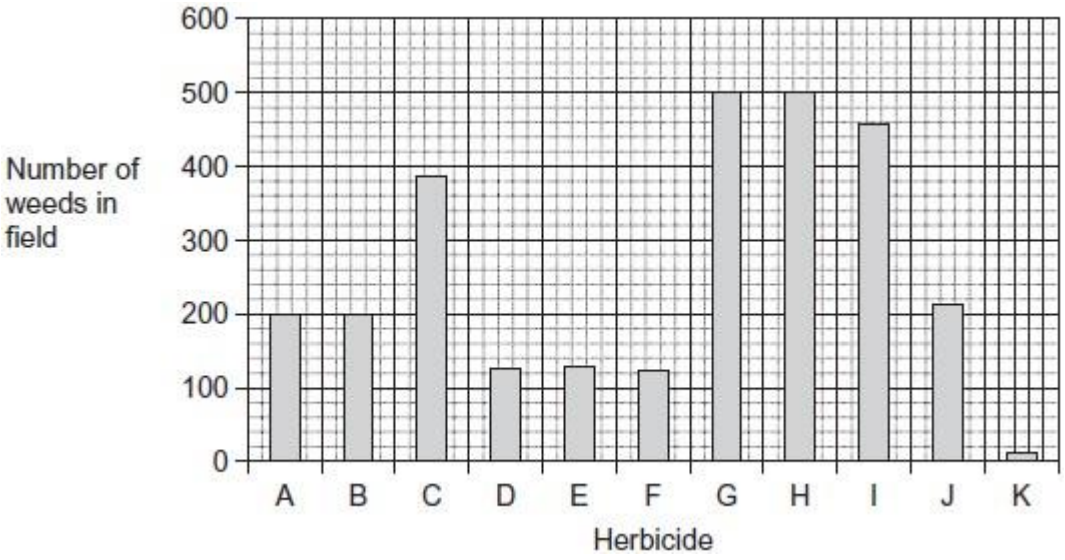
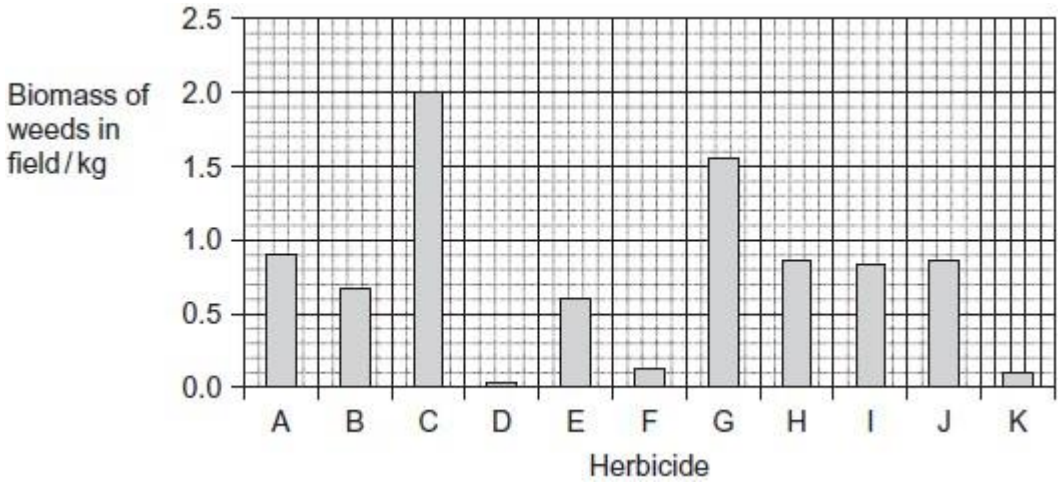


Figure 2



(a) Describe the difference in biomass of **each** of the weed plants in fields treated with herbicides **G** and **H**. Explain how you arrived at your answer.

(2)

(b) The farmers decided that **K** would be the best herbicide to use. Explain why herbicide **K** would give a higher crop yield.

(2)

(c) The farmers carried out their investigation during the summer.
Suggest **one** advantage and **one** disadvantage of carrying out this investigation during the summer.

Advantage _____

_____

Disadvantage_____

_____

(2)

(d) One of the farmers told a local newspaper reporter of their findings. The newspaperpublished an article with the following headline: “Local farmers show scientists the way to bigger crop yields.” Was this headline justified? Explain your answer.

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Extra space_____

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(5)

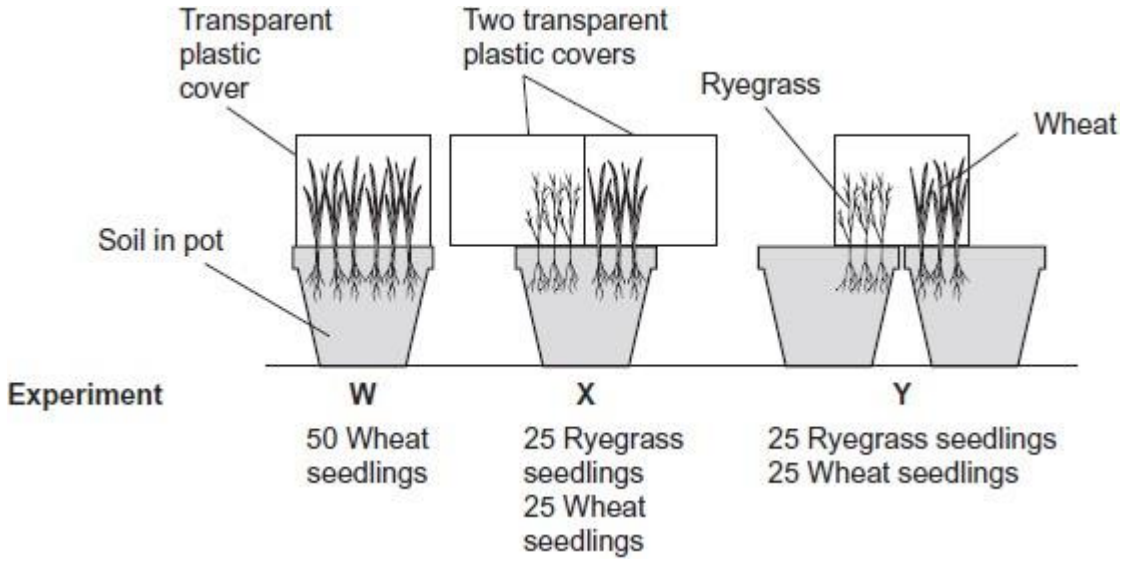
(Total 11 marks)

Wheat is an important cereal crop. Ryegrass is a weed in wheat fields. Wheat and ryegrass

26

belong to the grass family.

Scientists investigated competition between wheat and ryegrass seedlings. They set up three experiments **W, X**, and **Y** as shown in the diagram.



The table shows the mean dry mass of the wheat seedlings as a percentage of their dry mass when grown alone.

	Experiment		
	W	**X**	**Y**
Mean dry mass of wheat seedlings as a percentage of their dry mass when grown alone	100	76	46

(a) Experiment **W** was a control experiment. Explain the purpose of the control experiment in this investigation.

(2)

(b) What can you conclude from this investigation about competition between wheat andryegrass? Use the data in the table to support your answer.

(Extra space)

(4)

(c) Explain how a decrease in temperature could affect the outcome of this investigation.

(2)

(Total 8 marks)

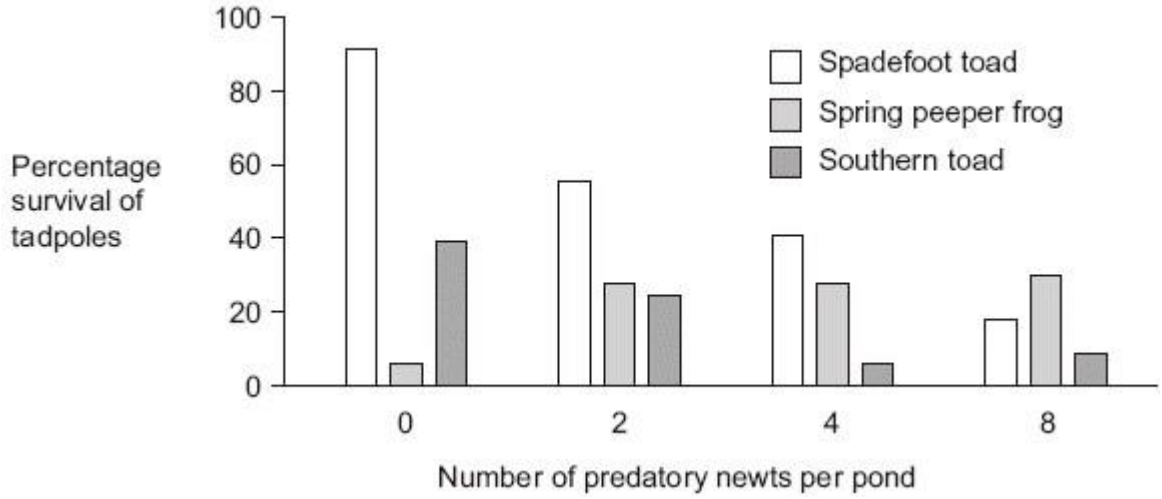
27 The young of frogs and toads are called tadpoles. Ecologists investigated the effect of predation on three species of tadpole. They set up four artificial pond communities.

Each community contained

- 200 spadefoot toad tadpoles
- 300 spring peeper frog tadpoles
- 300 southern toad tadpoles.

The ecologists then added a different number of newts to each pond. Newts are predators. **Figure 1** shows the effect of increasing the number of newts on the percentage survival of the tadpoles of each species.

Figure 1



(a) (i) Describe the effect of an increase in the number of newts on the percentage survival of the tadpoles of each of the **toad** species.

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_____

(2)

(ii) Suggest an explanation for the effect of an increase in the number of newts on the percentage survival of the tadpoles of spring peeper frogs.

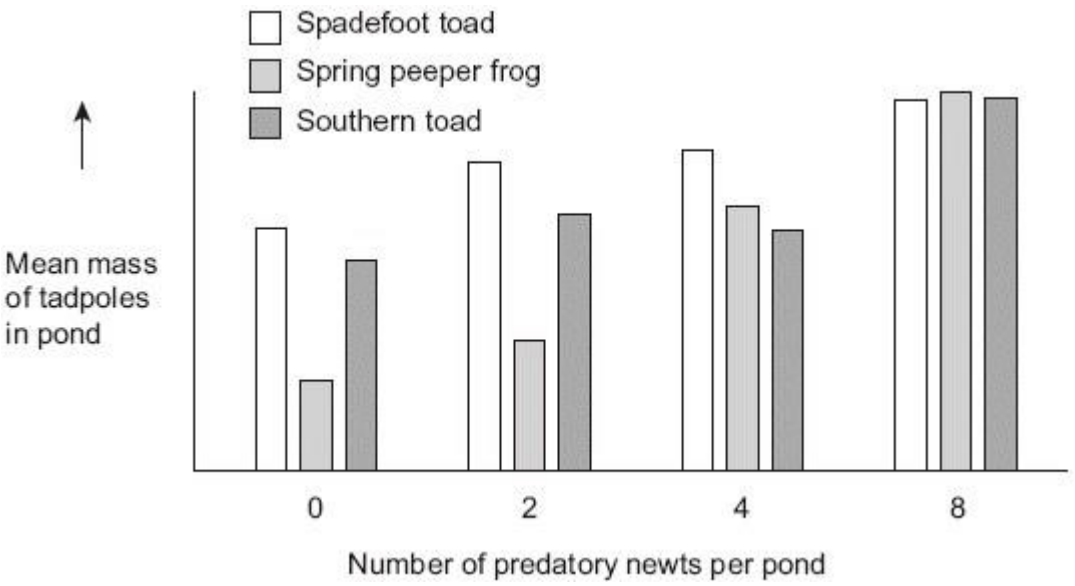
_____

_____

(2)

Figure 2 shows how the masses of the tadpoles were affected in each pond during the investigation.

Figure 2



(b) Using the information provided in **Figure 1** explain the results obtained in **Figure 2**.

(2)

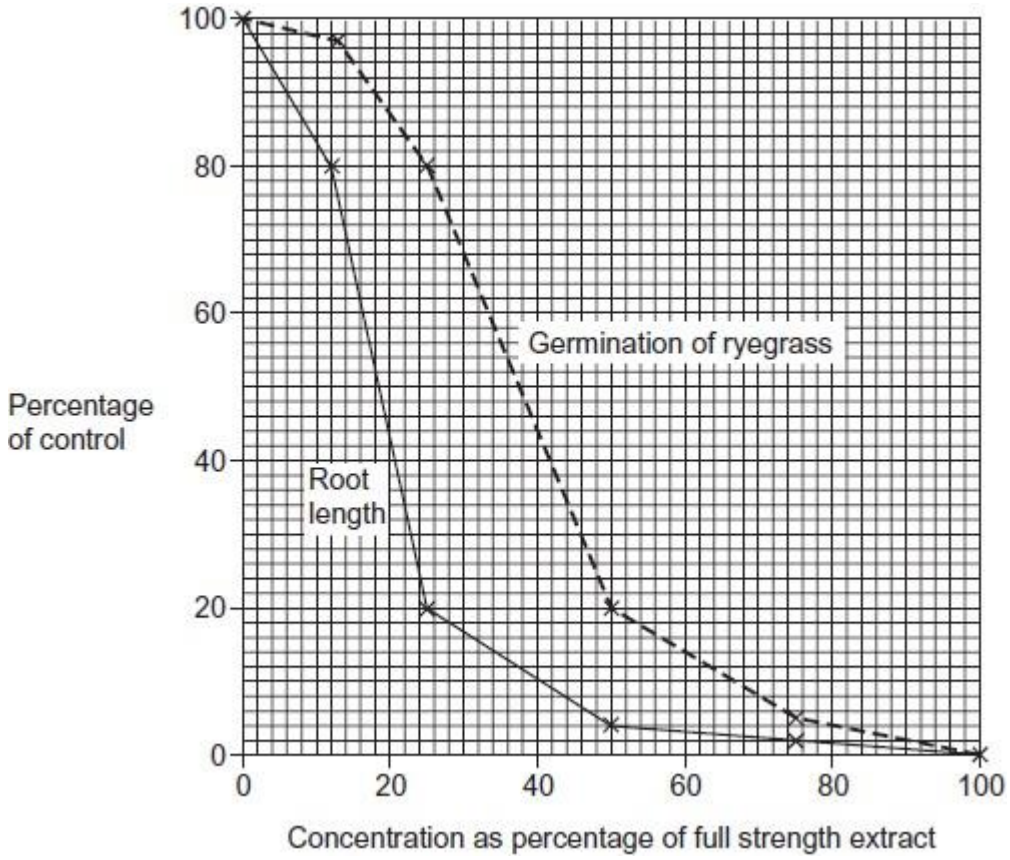
(Total 6 marks)

Australian scientists investigated one aspect of competition between wheat and ryegrass.

28

- They crushed up some wheat plants and mixed the crushed plants with distilled water.
- Water-soluble substances in the crushed plants dissolved in the distilled water. Thescientists called this solution the *full-strength* extract.
- The scientists then made a series of dilutions of the full-strength extract.
- They put ryegrass seeds into each dilution and recorded how many seeds germinated(started to grow). If the seeds germinated, they measured the lengths of the roots of the seedlings.
- They presented their results as percentages of a control experiment.

The graph shows the effects of different concentrations of the extract on the germination of ryegrass and on the length of the roots of the seedlings that grew from them.



(a) Describe the control that the scientists set up in this investigation.

_____

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(1)

(b) The scientists found a positive correlation between the inhibition of germination and theconcentration of the extract.

(i) Describe how they could find out whether this correlation was significant.

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(2)

(ii) Explain why a correlation does **not** mean that the extract caused inhibition of germination.

_____

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(1)

(c) The scientists concluded that wheat plants produce substances that help them to competewith ryegrass.

(i) Give evidence from the investigation to support this conclusion.

_____

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(2)

(ii) Why might their conclusion **not** be valid?

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(Extra space)

(3)

(Total 9 marks)

29 (a) Succession occurs in natural ecosystems. Describe and explain how succession occurs.

(5)

(b) Changes in ecosystems can lead to speciation. In Southern California 10 000 years ago a number of interconnecting lakes contained a single species of pupfish.

Increasing temperatures caused evaporation and the formation of separate, smaller lakes and streams. This led to the formation of a number of different species of pupfish. Explain how these different species evolved.

(5)

(Total 10 marks)

30 (a) Blue tits are small birds that live in woods. An ecologist estimated the size of the blue tit population visiting gardens near a wood in November.

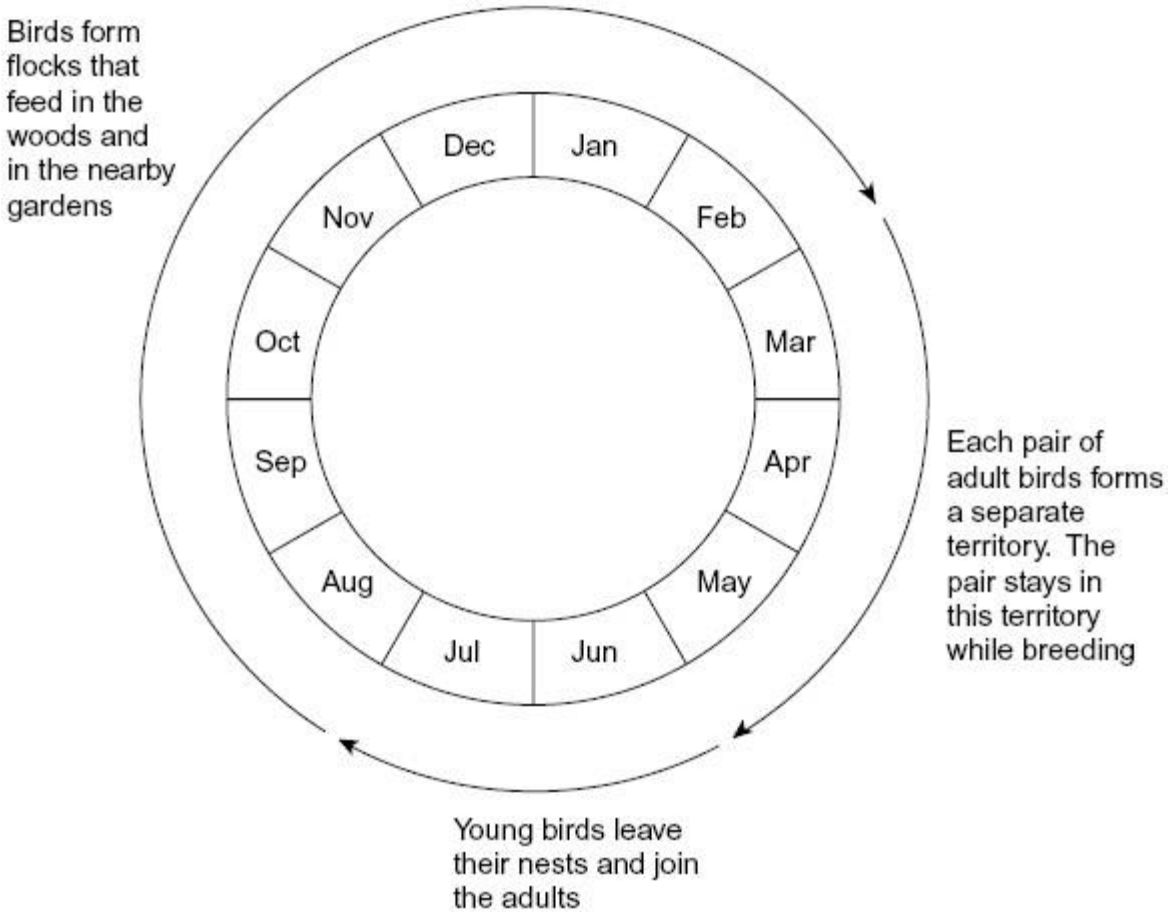
- She trapped 28 blue tits. She marked all of these birds with small metal rings on theirlegs.
- Two weeks later, she trapped another sample of blue tits. Of these birds, 18 weremarked and 20 were not marked.

Use the data to estimate the size of the blue tit population. Show your working.

Size of population _____

(2)

(b) The diagram shows some features of blue tit behaviour at different times of the year.



(i) Using mark-release-recapture to estimate the size of a blue tit population in Junewould **not** give reliable results. Explain why.

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_____

_____

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(2)

(ii) Using mark-release-recapture to estimate the size of a blue tit population in Marchwould **not** give reliable results. Explain why.

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(2)

(c) Whales spend most of their time deep in the sea but they come to the surface to breathe. When they are at the surface, scientists obtain small samples of their skin. The scientists find the base sequence in some of the DNA from these samples. The base sequence is different in each whale.

You could use the information about the base sequence to estimate the size of the whale population by using mark-release-recapture. Explain why.

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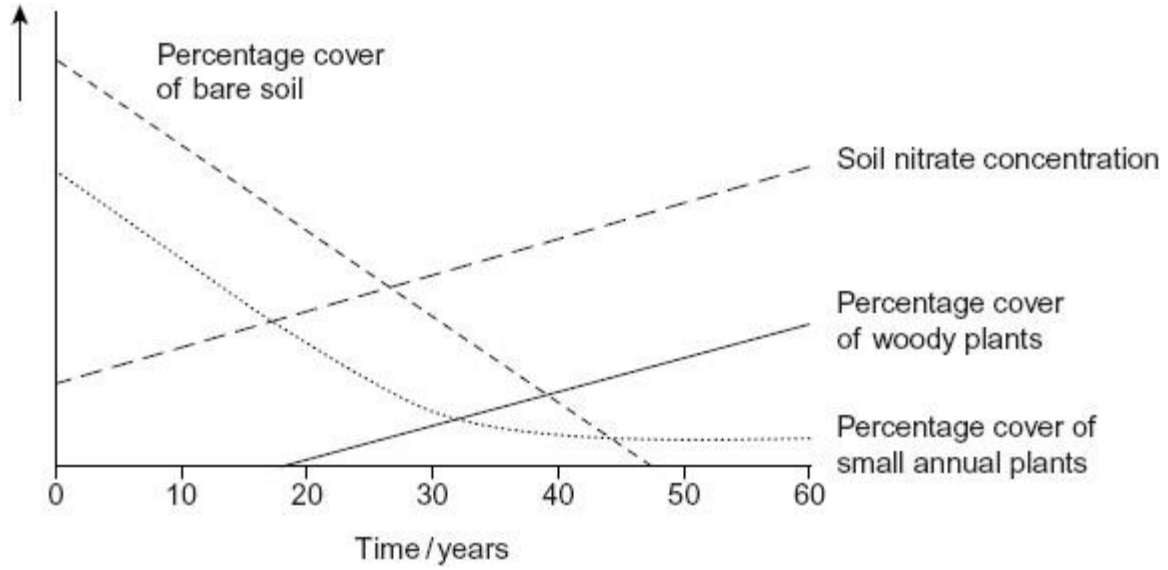
(2)

(Total 8 marks)

31 Ecologists investigated succession in some abandoned crop fields. The data that they collected are shown in the graph. The curves show the trends that occurred over a period of 60 years.



(a) Explain the change in soil nitrate concentration shown on the graph.

(2)

(b) The pioneer plants had different characteristics from the plants that colonised the fieldsafter 50 years.

(i) The pioneer plants had seeds that germinate better when the temperature fluctuates.

Explain the advantage of this to these pioneer plants.

(2)

(ii) Explain the advantage to a plant that colonises after 50 years of having a high rate ofphotosynthesis at low light intensities.

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_____

(1)

(c) Conservation of grassland habitats involves management of succession. Use the data inthe graph to explain why.

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(2)

(Total 7 marks)

32 A Sri Lankan scientist investigated the effect of human disturbance on the organisms living on a rocky seashore. He chose three areas for the study. These areas had different amounts of human disturbance.

The scientist measured human disturbance by walking from one end of the beach to the other. He recorded the number of people he encountered. **Figure 1** shows his results.

Figure 1

	Site **R**	Site **G**	Site **U**
Mean number of people encountered per hour (± standard deviation)	2.2 (± 2.1)	17.6 (± 9.6)	34.6 (± 11.6)

(a) (i) What conclusions can you draw about the number of people visiting Site **R** compared with the number of people visiting the other two sites? Give evidence from **Figure 1** to support your answer.

_____

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(2)

(ii) The scientist reported that the difference between the number of people visiting Site **R** and the number visiting the other two sites differed significantly ($p < 0.05$).

Use the words probability and chance to explain the meaning of *differed significantly ($p < 0.05$).*

_____

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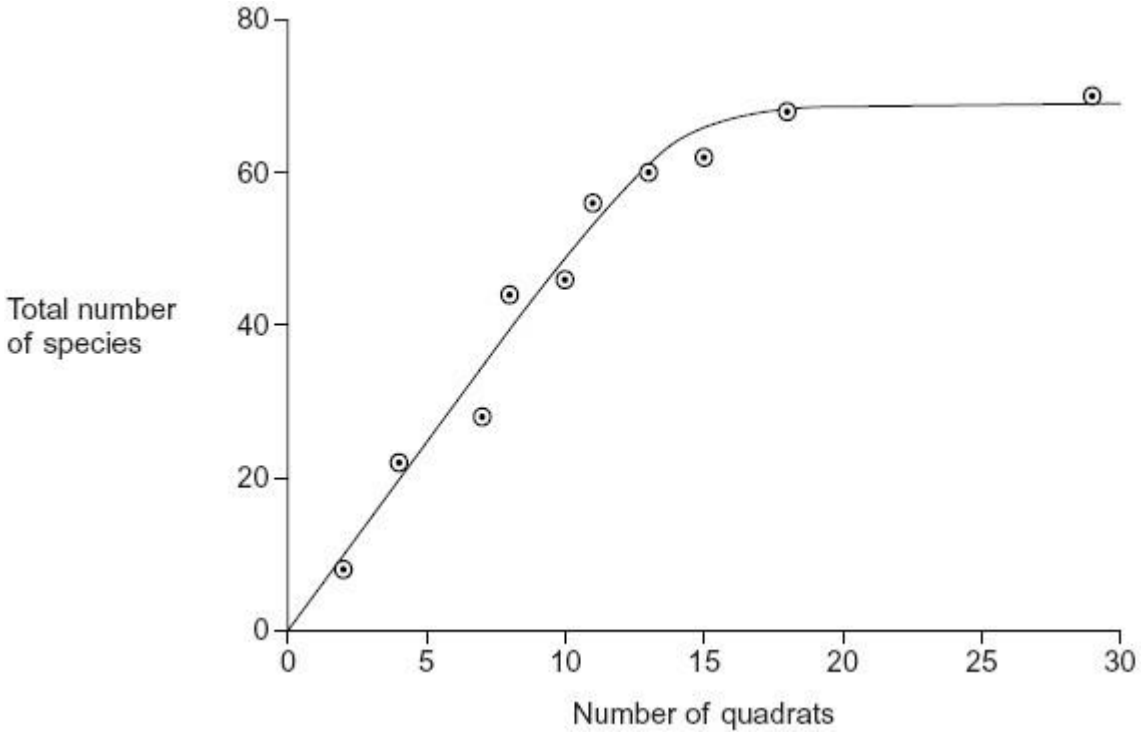
_____

(2)

(b) The scientist used quadrats to find the number of species at each of the three sites. He carried out a preliminary investigation and recorded the total number of species in an increasing number of quadrats. **Figure 2** shows the results.

Figure 2



(i) Use **Figure 2** to explain why 10 would **not** be an appropriate number of quadrats to use.

_____

_____

_____

(1)

(ii) Use **Figure 2** to explain why 25 would **not** be an appropriate number of quadrats to use.

_____

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(1)

The scientist measured the dry biomass of seaweeds at each of sites **R**, **G** and **U**. He collected all the organisms of a particular species in a quadrat and incubated them in an oven at a temperature of 80 °C.

(c) The scientist incubated the seaweeds at 80 °C. Suggest why incubating them at a higher temperature would **not** produce valid results.

_____

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_____

(1)

As well as measuring the dry biomass of the seaweeds, the scientist measured the dry mass of the animals present. He also measured the abundance of each species. **Figure 3** shows the data he collected.

Figure 3

	Site **R**	Site **G**	Site **U**
Mean number of people per hour	2.2	17.6	34.6
Mean number of species of seaweed per quadrat	4.2	2.1	1.3
Ratio of dry biomass of animals to dry biomass of seaweeds	0.15	0.06	0.03
Ratio of dry biomass of animals to abundance of animals	0.20	0.10	0.09
Ratio of dry biomass of seaweeds to abundance of seaweeds	0.79	1.57	3.24

(d) The ratio of the dry biomass of animals to the dry biomass of seaweeds is always a lot lessthan one. Explain why.

_____

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_____

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(2)

(e) (i) Conservation officers were working on the beaches used in this investigation. Theynoticed that there were fewer larger seaweeds on beaches used by a large number of people than on beaches visited by only a few people. Explain how the data in **Figure 3** support this.

(2)

(ii) What conclusions can you draw from the data in **Figure 3** about the effect of human disturbance on the animals living on the seashore? Explain your answer.

(4)

(Total 15 marks)

Resource A

33

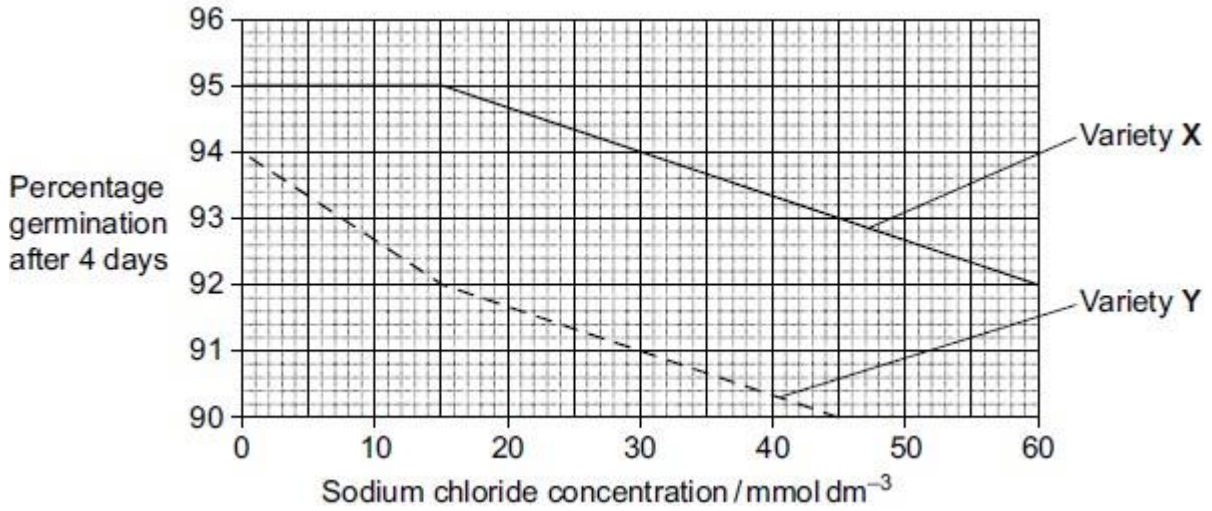
Lettuce growers investigated the best conditions for germinating lettuce seeds. They soaked lettuce seeds for 8 hours in distilled water at different temperatures. They then germinated some of the seeds at 20 °C and some at 35 °C. The table shows their results.

Temperature at which seeds were soaked / °C	Percentage of seeds which germinated

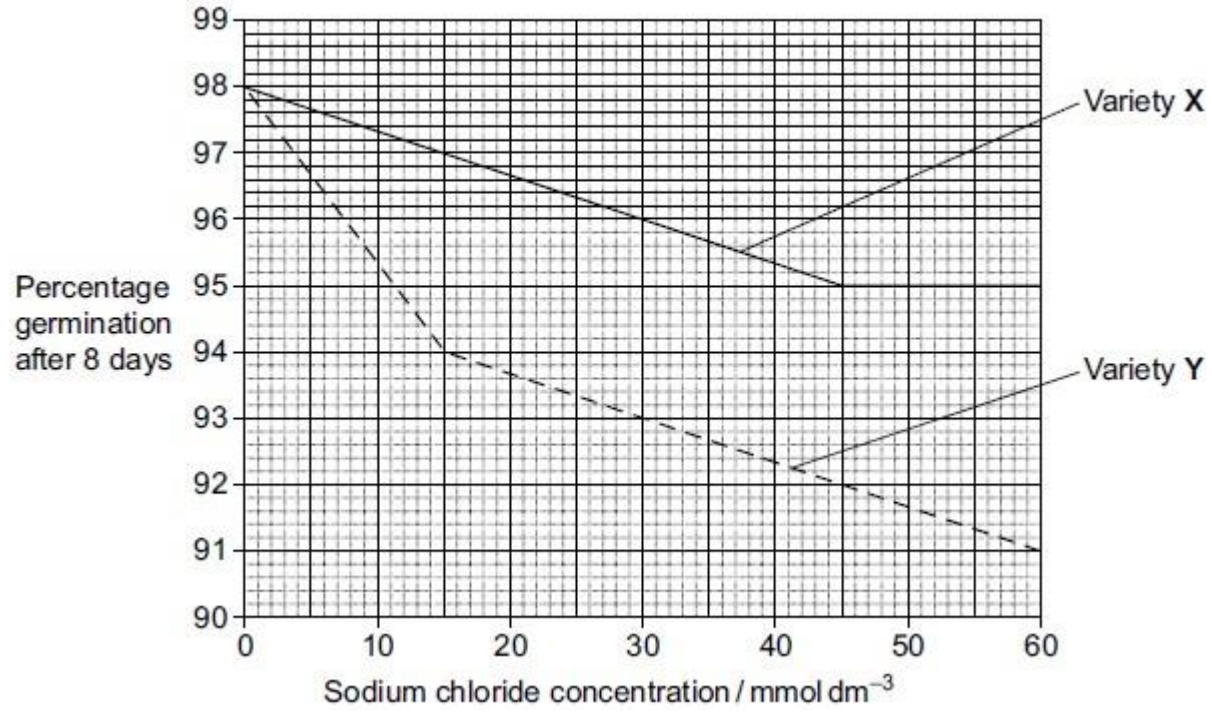
	at 20 °C	at 35 °C
20	100	89
25	100	43
30	41	1
35	21	0

Resource B

Scientists investigated the effects of different concentrations of sodium chloride on the germination of the seeds of two varieties of barley. The seeds were soaked for one hour in different concentrations of sodium chloride solutions and then germinated in distilled water at 25 °C. The scientists found the percentage of germinated seeds after 4 days and again after 8 days.

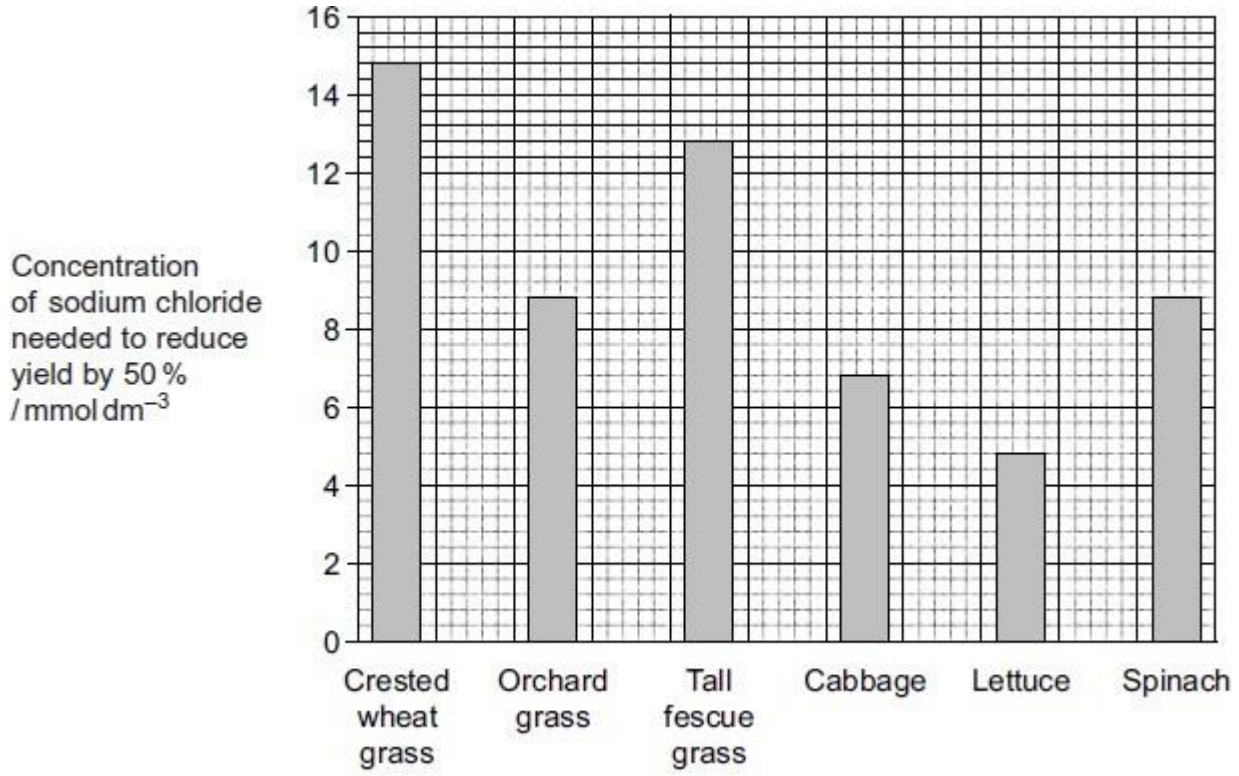


Percentage germination of barley seeds after 8 days



Resource C

The Food and Agriculture Organisation is investigating the effect of salt on plant growth. In some countries the water used to irrigate crops contains sodium chloride. The graph shows the effect of sodium chloride on the growth of some grasses and crop plants.



Resource D

Salt is used frequently on the roads in Canada during the winter months. The Highways Agency wants to plant salt-tolerant trees on roadside verges. They surveyed a range of roadside trees to determine how salt-tolerant they were. In the survey each tree was growing in soil with a similar salt concentration.

Tree Species	Number of trees surveyed	Percentage of trees in each class			Mean concentration of chloride ions in the tissues of roadside trees / arbitrary units
		Healthy	Slightly injured	Moderately to severely injured	
Red oak	108	100	0	0	0.02

Paper birch	3	100	0	0	1.15
Black cherry	36	92	8	0	0.09
Basswood	54	57	41	2	0.90
Red maple	282	63	11	26	1.01
Red pine	140	9	15	76	1.08

(a) The scientists concluded that red oak and paper birch are salt-tolerant but that the other species of tree are not. Use the data in **Resource D** to evaluate their conclusion.

(Extra Space)

(4)

(b) Farmers have suggested that using salt on the roads in winter is damaging the yield from their land. Do the data in the resources above support this claim?

(Extra Space)_____

(4)

(Total 8 marks)

34 Lettuce is classified in the same family as dandelions. Dandelions commonly grow on roadside verges and may accidentally be sprayed with salt when salt is added to the road in winter.

Describe how you could use a transect to investigate whether the distribution of dandelions changed with increased distance from the road.

*(Extra space)*_____

(Total 4 marks)

35 The Harvest Index is the percentage of dry biomass that is harvested and used.

Barley is a cereal. It is grown for its grain. Researchers collected data to calculate the Harvest Index of barley growing in a small field. They obtained their measurements from quadrats at different places in the field. Their results are shown in the following table.

Quadrat number	Dry biomass of barley plants / g m^{-2}	Dry biomass of barley grain harvested / g m^{-2}
1	80	42
2	75	37
3	82	41
4	93	39

(a) Use the data for quadrat number **4** in the table to calculate the Harvest Index for barley. Show your working.

Harvest Index = _____

(2)

(b) Plant breeders are trying to produce barley plants with shorter stems.Explain how this would increase the Harvest Index.

_____

_____

(1)

(c) The values for the biomass of the barley plants are different in each quadrat.Suggest an explanation for this difference.

(2)

(d) The researchers measured the dry biomass of the barley plants and the barley grain.What is the advantage of using dry biomass for these measurements?

(2)

(Total 7 marks)

Mark schemes

1

(a) (No – no mark)

Graph / bar chart only shows number of species, not the name of the species.

1

(b) (No – no mark)

1. Mutations are spontaneous / random;
2. Only the rate of mutation is affected by environment;
3. Different species do not interbreed / do not produce fertile offspring;4. So mutation / gene / allele cannot be passed from one species to another.

Ignore references to correlation does not prove causation

4

(c) 1. Initially one / few insects with favourable mutation / allele;
2. Individuals with (favourable) mutation / allele will have more offspring;
3. Takes many generations for (favourable) mutation / allele to become the mostcommon allele (of this gene).

3

[8]

2

(a) Community;

1

(b) (Less) competition for food/resource;

Ignore: competition for niche/habitat.

Accept: space/named resource.

Reject: intraspecific competition.

1

(c) 1. Correlation **but** does not mean a causal effect;

Ignore: positive/ negative (correlation).

2. Other abiotic/biotic/named factor involved;

Accept: due to presence/absence of fish.

Reject: 'other factors' unless further qualified.

3. Variation in numbers of beetles species at same/similarparticular pH;

Accept: same number of beetles at different pHs.

Accept: 'scattered results' / 'anomalies' / 'spread of results'. 4. Large sample;

Max 3

(d) Fish feed on predator/consumer of water beetle;

Accept: beetles feed on fish/faeces.

1

[6]

(b) 1. Respiration/metabolism/ammonification;

3

2. (Releases/produces) heat;

Reject: 'produces energy'.

2

(c) 1. SD is spread of data around the mean;

Accept: variation around the mean.

*Accept: range is difference between highest and lowest values/extremes **or** range includes anomalies/outliers.*

2. (SD) reduces effect of anomalies/ outliers;

Reject: (SD) removes anomalies/outliers.

3. (SD) can be used to determine if (difference in results is) significant/not significant/due to chance /not due to chance; *Ignore: reliability/accuracy/validity.*

2 max

(d) 1. Distributes heat / prevents 'hot' spots;
2. Distributes microorganisms;
3. More enzyme-substrate complexes;
4. Increases rate of decomposition;

Accept: increases nitrification/ammonification or 'breaks down waste faster'.

5. Aeration/provides oxygen;

2 max

(e) 1. Microorganisms change the abiotic conditions/temperature /organic waste /provide nutrients;

Must refer to microorganisms or bacteria/named bacteria causing the change.

Ignore: change the environment.

2. Less hostile conditions;
3. Decline in Cocci **and** increase in rods;

Accept: 'decrease in cocci, others are going up'.

Accept: decrease in cocci and increase in either rod type or increase in both types.

4. Gram positive outcompete / better competitors;

Accept: rods outcompete (cocci) / better competitors.

3 **max**

[9]

4

(a) 1. (Use) coordinates / number the rocks/sites/squares;

Ignore: references to grid, tape measures, metre rulers etc.

2. Method of generating/finding random numbers e.g. calculator/computer/random number generator/random numbers table;

Accept: numbers out of a hat / use of dice.

2

(b) Difficult/too many to count / individual organisms not identifiable /too small to identify/count / grows in clumps;

Ignore: easier/quicker/representative/ more accurate, unless qualified.

1

(c) Any suitable factor with valid explanation = 1 mark

1. Wave action - firmer grip on rock is necessary (at either site);
2. Wind/air movement/less humid - more evaporation at site A / more(physical) damage;
3. Light – (linked to) photosynthesis (at either site);
4. Temperature – (linked to) photosynthesis/respiration/enzymes/evaporation (at either site);
5. pH – (linked to) enzymes/proteins;

Note: other common factors include salt (salinity) linked to water potential / named nutrient e.g. nitrate linked to protein/DNA.

Ignore: carbon dioxide/oxygen/pollution/rainfall/food/nutrients.

Reject: biotic factors e.g. predation.

2 max

(d) 1. Greater variety of food / more food sources;

Ignore: more food.

2. More/variety of habitats/niches;*Ignore: homes/shelters.*

Accept: different habitats.

2

(e) (i) 1. (So they were) hungry/not full;

Accept: description of hunger e.g. appetite / 'empty stomach'/'so they eat'.

2. (Allows) comparison;

2

(ii) 1. Alga without consumer/named consumer/animal;

Accept: repeat experiment without consumer.

Accept: in separate tank / in tank where not eaten.

2. (Find change in mass) in dark;
3. For 50 hours;

Accept: 'same time as in experiment'.

Accept: For lower time period then scaled up to 50.

3

(iii) 1. For *Laurencia pacifica* **and** *Cystoseira osmondacea* (difference in results) significant /reject null hypothesis / not due to chance / less than 5%/0.05 probability due to chance;

Accept: for Laurencia pacifica 'less than 1%/0.01 probability'.

2. For *Egregia leavigata* **and** *Microcystis pyrifera* no significant (difference in results)/accept null hypothesis / is due to chance/more than 5%/0.05 probability due to chance;

Accept: 'insignificant' for 'no significant difference'.

3. (Difference in results) for *Laurencia pacifica* is the most significant;

Note: reference to probabilities on their own is not sufficient.

1, 2 and 3. Accept: abbreviations for all species.

3

[15] (a) 9 (hours);;

5

If multiply 75 by 0.11 and 0.23 but wrong answer, then 1 mark

*Accept for **one** mark if multiply 75 by two wrong proportions near to 0.11 ± 0.01 and 0.23 ± 0.01 or multiply by the difference between the two (wrong) proportions*

2

(b) (Yes because)

1. Both/Each species (mean) time spent looking around greaterwhere many predators;
2. Differences (appear to be) significant because SDs do notoverlap;

(No because)

3. Wildebeest spend same (mean) time looking around wheremany predators as impalas where few predators;
4. Don't know what they are looking for (when heads up);
5. Habitats might be different in different areas (which couldaffect the behaviour);

Accept 'mean proportion' means 'time'

1. Require idea of both, not just quoting numbers

2. This point must be in the context of point 1

2. Do not accept results significant

2. Accept 'because bars do not overlap'

2. Do not accept SE for SD

3. Accept overlap in SD as equivalent to same time

5. Ignore 'other factors' unqualified and discussions of experimental variables

4 max

(c) 1. Less time spent feeding
OR
More energy lifting head/looking round;
2. (So) less food/biomass for respiration
OR
less energy for growth/reproduction/care of young;
OR
3. Raising head makes them more visible to predators;
4. So more likely to be attacked/eaten/killed;

2. Accept any appropriate suggestion of less energy for something to do with life of the herbivore

2. Allow less food/biomass for growth/reproduction

2. Ignore references to energy for respiration

2

[8]

(a) (i) Unit of energy / mass, per area, per year.

6

1

(ii) 1. Less light / more shading / more competition for light;

Neutral: references to animals

2. Reduced photosynthesis.

Accept: no photosynthesis

2

(b) 1. Pioneer species;
2. Change in abiotic conditions / less hostile / more habitats / niches;

Accept: named abiotic change or example of change e.g. formation of soil / humus / organic matter / increase in nutrients Neutral: reference to change in environment unqualified Neutral: more hospitable / habitable / homes / shelters

3. Increase in number / amount / diversity of species / plants / animals.

Accept: other / new species (colonise)

3

(c) 1. Net productivity = gross productivity minus respiratory loss;
2. Decrease in gross productivity / photosynthesis / increase in respiration.

2

(d) 1. Conserving / protecting habitats / niches;
2. Conserving / protecting (endangered) species / maintains / increases (bio) diversity;
3. Reduces global warming / greenhouse effect / climate change / remove / takeup carbon dioxide;
4. Source of medicines / chemicals / wood;
5. Reduces erosion / eutrophication.

Accept: tourism / aesthetics / named recreational activity

1 max

[9]

7

(b) 1. Geographic(al) isolation;

2. Separate gene pools / no interbreeding / gene flow (between populations);

Accept: reproductive isolation

This mark should only be awarded in context of during the process of speciation. Do not credit if context is after speciation has occurred.

3. Variation due to mutation;
4. Different selection pressures / different abiotic / biotic conditions / environments / habitats;

Neutral: different conditions / climates if not qualified

Accept: named abiotic / biotic conditions

5. Different(ial) reproductive success / selected organisms (survive and) reproduce;

Accept: pass on alleles / genes to next generation as equivalent to reproduce

6. Leads to change / increase in allele frequency.

Accept: increase in proportion / percentage as equivalent to frequency

6

(c) 1. Capture / collect sample, mark and release;
2. Method of marking does not harm lizard / make it more visible to predators;

3. Leave sufficient time for lizards to (randomly) distribute (on island) beforecollecting a second sample;
4. (Population =) number in first sample × number in second sample divided bynumber of marked lizards in second sample / number recaptured.

4

(d) 1. High concentration of / increase in carbon dioxide linked with respiration at night / in darkness;
2. No photosynthesis in dark / night / photosynthesis only in light / day; *Neutral: less photosynthesis*
3. In light net uptake of carbon dioxide / use more carbon dioxide than produced / (rate of) photosynthesis greater than rate of respiration;
4. Decrease in carbon dioxide concentration with height;

More carbon dioxide absorbed higher up

Accept: less carbon dioxide higher up / more carbon dioxide lower down

5. (At ground level) less photosynthesis / less photosynthesising tissue / more respiration / more micro-organisms / micro-organisms produce carbon dioxide.

Neutral: less leaves unqualified or reference to animals

5

[15]

8 (a) 1. No / few consumers / pests / pathogens;

Accept: No / few predators.

Accept: description of competition for a named resource with reference to 'other species'.

Accept: More resistance to disease.

2. Outcompetes / better competitor for resources / light / CO_2 / abiotic factor / ideal niche;

Neutral: competition for food.

2

(b) 1. (Cost of) control / removal;

2. (Cost of) restoring habitat / conservation;

3. (Loss of income) from fishing;

4. (Loss of income) from boating / tourism / recreation;

Accept: any valid recreational activity e.g. canoeing.

2 max

(c) (i) 1. Removes water;

2. Water content can vary in sample / plant;

Note: Reweighing / constant mass indicates all water removed = 2 marks. ;

2

(ii) 1. 0.5 is not effective / has little effect / 1.0 is less effective (than 5.0) / concentrations below 5.0 less effective;

Accept: for first 3 mark points effect on growth / biomass as a measure of effectiveness.

Accept: references to 'this concentration' = 5.0.

Accept: 5.0 is the minimum effective concentration.

1. and 2. 5.0 is the minimum effective concentration that reducesgrowth = 2 marks.

2. At 5.0 biomass / growth is reduced;

3. Small difference between using 5.0 and 25.0;

4. Using 5.0 is cost effective / using 25.0 is expensive / high concentrationsmay affect the environment / other organisms / chemical may remain in habitat / bioaccumulation;

Accept: any impact on the habitat e.g. contaminate water supply.

4

(e) (i) To compare / see effect with / without fungus / fluridone / control agent / s;*Neutral: for comparison on its own.*

Neutral: to see effect of variables / results / treatments / factors without further qualification.

1

(ii) 1. Is specific / grows / survives in Hydrilla / habitat;

Accept: 'known to work'

2. Can reproduce / only one application required;

3. Does not become a pest;

2

(iii) 1. Fluridone / chemical acts quickly / quickly reduces Hydrilla;

2. Fungus / biological control keeps Hydrilla in low numbers / fungus / biological control works over a long time / can reproduce / resistance does not develop against fungus / biological control;

2

[15] (a) (i) (Organisms that) can breed together / interbreed **and** produce fertile offspring;

9

Need both aspects. Reject 'inbreed'

Reject viable offspring

1

(ii) Same number (of organisms) in each region / (organisms) equally spread;

Allow other ways of expressing 'region' or 'equally spread', eg not clumped together, same number per unit area

1

(b) $P = \frac{AS}{R}$;;

2 marks for correct answer

*1 mark for having **A** on top of equation (recognises that total population related to total area)*

Note:

P = A × S / R or
P = A / R × S

are also correct.

Allow 1 mark for $\frac{S}{P} = \frac{R}{A}$

2

(c) (i) *In mark–release-recapture (technique)*

Accept converse by considering assumptions of proportional sampling

1. No assumption that organisms are uniformly distributed;

2. Size of total area / size of sampled region not required;

Marking point 1 or marking point 2 do not have to start with the same technique

In this case, allow difference by implication i.e. do not penalise if the two techniques are not compared

2

(ii) Animals are from / all part of the same population;

1

[7]

10 (a) *Ulva lactuca*;

Reject: Ulva on its own

Accept: lactuca on its own

Accept: Incorrect spelling

1

(b) (i) Difficult / too many / too many to count / individual organisms not identifiable /too small to identify / grows in clumps;

Neutral: easier / quicker / representative / more accurate, unless qualified

1

(ii) Any described feature of concrete eg texture / flat / composition chemicals / nutrients etc;

Neutral: not natural / man made / are different, without further qualification

1

(c) 1. Pioneer species / *Ulva* increases then decreases;

1 and 4. Growth / reproduces = increases. Dies = decrease

2. Principle of a species changing the conditions / a species makes the conditions less hostile;

2. Accept description of change in conditions egsoil / humus forms, nutrients increased

3. New / named species better competitor / previous / named / pioneer speciesoutcompeted;

Pioneer species grows, dies and forms humus = 2 marks

G. coulteri / Gelidium outcompetes other / named species = 2 marks

4. *G. coulteri / Gelidium* increases <u>and</u> other / named species decreases;

4

[7]

11

1.P Pathogens and effects on host

2.T Taxonomy

2.C Classification and evolution.

2.I Inheritance and evolution

2.Gc Genetic code, universal

2.B Behaviour

2.Ev Populations and evolution, variation between individuals within a species

3.BP Relationships within ecosystems − eg predator / prey

3.E Energy transfer in ecosystems

3.N Nutrient cycles, the organisms involved

3.S Succession, biodiversity, species and individuals in a community

4.H Human impacts on the environment and its effect on relationships between organisms − including farming

4.Gt Gene technology and GMO and selective breeding

4.Ar Antibiotic resistance

Examiners are free to select other letters if they wish

The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves

Breadth, one mark for use of an example from each of the following approaches − 3 max:

1. Pathogen and host

2. Evolution (related topics)

3. Ecological

4. Human intervention in relationships

12

[25] (a) (i) 1. No overall pattern / pattern (of right or left most common) is not the same for all islands;

Allow expression in other ways e.g. three islands show left on top is more common

2. For **(B) C** and **E** there is little difference;

3. Large differences on **A** *and* **D** *and* opposite ways (to each other);
Need both aspects but allow other expressions of 'opposite ways'

2 max

(ii) 1. Can record all individuals on (small) islands;

2. (So) no / less sampling error;

3. (Maybe) different rates of mutation / different selection pressures /different environmental conditions;

4. Inbreeding / breeding with close relatives (more likely);

5. (Little) gene flow / (more chance of) genetic drift;*Accept reference to either of these ideas for this point*

2 max

(b) 1. If R is recessive, R × R parents cannot produce L offspring;
Accept use of genetic diagrams to illustrate points 1 and 2

2. If L is recessive, L × L parents cannot produce R offspring;*Accept right arm on top as R etc.*

3. R × R **and** L × L parents produce both types of offspring; *Need reference to two parent crosses for this mark*

3

(c) Both L and R in a set of twins / (some) twins show different arm-folding;

1

[8]

13 (a) 1. Decrease in (percentage cover) of bare ground / water linked to more plants / species / increase in plant coverage;
*Allow **one maximum mark** for answers which describe all three changes **without** a suitable explanation for any change*
Must be idea of more / increase not just change in species / plants

2. Change in diversity / number of plant / species / named (species) as abioticconditions altered / due to competition / more soil / less hostile;
Accept pioneer species replaced due to competition
Accept description of change in species
Accept 'more suitable' = less hostile

3. Increase in depth of soil as plants die / humus formed;

3

(b) 1. Greater variety of food / more food sources;

'More food' = neutral

2. More / variety of habitats / niches;

Ignore 'more homes' or reference to 'shelters'

2

(c) (i) 1. Marking is not removed / marking does not affect survival / predation;

2. Limited / no immigration / emigration;

Accept 'migration' and descriptions of immigration / emigration

2. and 4. Increase / decrease in population is not sufficient – theremust be a reason

3. Sufficient time for (marked) individuals to mix (within the population);*Accept – 'For mixing to occur between samples'*

4. No / little births / deaths / breeding;

5. Sampling method is the same;

Ignore 'random sampling'

2 max

(ii) Correct answer of ...34 = 2 marks;

***Allow one mark** for an answer of 51 as candidate has misinterpreted the second sample as being = 30*

Incorrect answer but shows correct formula in words or numbers
e.g. 17 × 20 ÷ 10;

Reject correct formula multiplied by 100

2

[9] (a) Crabgrass;

14

Reject: grass or grassland

Reject: crabgrass if another organism is also included

1

(b) 1. Species / plants / animals change the environment / conditions / add humus /nutrients etc. / less hostile (habitat);

Accept 'they' for species / plants in mark points 1 and 2

2. Species / plants better competitors;

2

(c) (Only) plants which can photosynthesise with less light (remain);

Accept converse but do not award mark for idea that plants cannot photosynthesise and die because there is no light

Answers must be in context of being or not being able to photosynthesise with less light

1

[4]

15

(a) 0.8;

1

(b) (i) 1. Aerobic respiration;

1. Allow description e.g. respiration using oxygen

1. Accept 'oxidative phosphorylation'

2. Increase in uptake (of oxygen) with growth / reproduction / division ofyeast cells;

3. Glucose / nutrients / oxygen decreases / becomes limiting / cells die /ethanol / toxins form / heat produced / anaerobic respiration occurs;

3. Ignore any reference to time

3. Accept decrease in oxygen being linked to oxygen being 'used up' or equivalent

3

(ii) 1. (Ethanol produced) by anaerobic respiration / from pyruvate in anaerobic conditions;

1. 'Fermentation' is not enough on its own

2. (Ethanol / anaerobic respiration) increases as oxygen (uptake /concentration) decreased / decreases as glucose is used up / ethanol kills cells;

2

(c) 1. Oxygen uptake decreases / stopped;

2. Oxygen is final (electron) acceptor / combines with electrons (and protons);

3. Ethanol produced sooner / more ethanol produced;

3. Accept ethanol produced at any specified time before 16 hours

3

[9] (a) All / group of species / all / group of populations / all the organisms;

16

Accept equivalent terms for group.

*Answers which only refer to organisms must have idea of **all** the organisms not just a group of organisms*

Reject answers which include 'environment' or abiotic factors as part of the definition

1

(b) (i) 7.2 - 8.4 (metres);

Accept answer of 1.2

1

(ii) 1. Food / prey / oxygen;

Do not accept 'resource' for mark point 1 unless this is qualified as food / prey / oxygen

2. Less / no competition;

Reference to light and CO_2 as a resource negates mark point 2

Ignore intraspecific / interspecific for mark point 2

2

(c) 1. Increase in depth linked to decrease in temperature / decrease in depth linkedto increase in temperature;

Accept increase or decrease in temperature is related to 'higher depth' or 'lower depth' due to ambiguity of these terms

2. Correlation / relationship between temperature and fish distribution does notindicate a causal effect;

Ignore any reference to correlation unless it is clearly in context of temperature and fish distribution

3. Overlap in ranges / different fish / species occupy same depth;

Temperature does not determine fish distribution is not sufficient for idea of causal effect

4. Other abiotic / biotic / named factor involved;

Reject: 'casual' for mark point 2

Reject 'other factors' for mark point 4 unless further qualified

3 max

[7]

17

(a) 1. Quadrats placed at intervals along transect;

2. Number of seeds counted per quadrat to calculate seeds per m^2;

2

(b) (i) 1. Wind from North East;
Accept blowing to South West

2. Seeds blown further;

2

(ii) 1. Seeds have different distances to fall / seeds have different times in air;

2. Blown by wind a different amount;

3. (Candidates investigation) shows that seeds travel further when droppedfrom higher;
Supported by reference to candidate's investigation

2 max

(c) (i) 1. Produces large number of seeds / produces seeds blown by wind;

2. Greater probability (of colonising);
Accept greater chance

2

(ii) 1. Small size;

2. Too little food in seed to become established;

3. Not enough light for photosynthesis;

2 max

[10]

18

(a) (i) Each treatment occurs in each row <u>and</u> each column;
Ignore references to random

1

(ii) 1. Different environments or different variables in the field / in different plots / variables change across rows / down columns / from one side to another;

2. Minimises / removes the effect of variables;

2

(b) Standardising any two relevant factors, for example:

To gain credit here, factor must be something that the scientists could do and must relate to field conditions

1. Water;
2. Fertiliser / manure / soil nutrient;
3. Weed killer;
4. Soil pH;

Reject answers such as keep light / carbon dioxide / temperature constant

2 max

(d) (i) 1. Survival falls as time increases;

2. Survival falls as sowing density increases;

3. Up to 15 / 25 seeds per m^2 all survive / above 250 seeds per m^2 survival falls rapidly;

3

(ii) 1. Intraspecific competition / competition between bean / soya plants / for water / nutrients / light;

2. Greater as plants grow / increase in size;

2

[10]

19

(a) 1. Competition (from) parent tree;

2. (From) large number of seeds;

3. For light / nutrients / water;

3

(b) 1. Few seeds / young plants;

2. Interspecific competition / unsuitable conditions means not all survive;

2

20

[5] (a) 1. Place transect up / down shore / transect from low to high tide;

Must give direction

2. Use quadrats at regular / measured / known intervals;

3. Repeats / more than one quadrat at each interval;

3

(b) 1. *U. pertusa* will be uncovered for most of the day / *M. yendoi* is covered by sea water most of the time;

2. Thick walls will allow *U. pertusa* to withstand desiccation / thick walls will reduce damage / thick walls will provide support; *Accept description of desiccation.*

3. *U.pertusa* better competitor / better adapted in uncovered areas;

3

[6]

21

(a) All the fish / all the species / all the populations / all the organisms;

Must indicate all / every species.

Reject answers that suggest other fish / organisms might be present.

1

(b) (i) 1. Capture sample, mark and release;

2. Appropriate method of marking suggested / method of marking does not harm fish;

E.g. Cutting a fin / attaching a tag / paint / marker.

3. Take second sample and count marked organisms;

May be awarded from equation if not given here.

4. $$\text{Population} = \frac{\text{No in sample}_1 \times \text{No in sample}_2}{\text{Number marked in sample}_2};$$

Accept any valid alternative to equation or answer expressed as a ratio.

3 max

(ii) One suitable reason;

Accept other valid answers, which must, however, relate to breeding / only works if population constant.

E.g. population increases / changes (between first and second sample)

1

(c) 1. With different mouth eats different food / has different way of feeding / specificmouth shape for specific food;

Catches more food and gas exchange are neutral

2. Competition between species / interspecific competition is reduced;

Reject intraspecific

2

22 **[7]** (a) (i) Non-living / physical / chemical factor / non biological;

Do not accept named factor unless general answer given.

1

(ii) Accept an abiotic factor that may limit photosynthesis / growth;

Reject altitude / height

Water

Named soil factor

Not "soil" / "weather"

Light

Carbon dioxide

Accept Oxygen

Incline / aspect

Wind / wind speed

1

(b) 1. Correct explanation for differences between day and night e.g.photosynthesises only during the daytime / no photosynthesis / only respiration at night;

2. Net carbon dioxide uptake during the day / in light

OR

No carbon dioxide taken up at night / in dark / carbon dioxide released at night / in dark;

3. At ground level more respiration / in leaves more photosynthesis;

4. Carbon dioxide produced at ground level / carbon dioxide taken up in leaves;

Principles

Comparing day and night / light and dark

1. Explanation in terms of photosynthesis / respiration

2. Effect on carbon dioxide production / uptake

Comparing leaves with ground level

3. Explanation in terms of photosynthesis / respiration

4. Effect on carbon dioxide production / uptake

2 and 4 must relate to why the change occurs

4

(c) 1. Variation in original colonisers / mutations took place;

2. Some better (adapted for) survival (in mountains);

2. Allow "advantage so able to survive"

3. Greater reproductive success;

4. Allele frequencies change;

4. Reject gene / genotype

3 max

[9] (a) 1. Transect / lay line / tape measure (from one side of the dune to the other);

23

1. & 2. Reject random in context of placing transect / quadrats

2. Place quadrats at regular intervals along the line;

Accept references to stratified sampling / different seral stages

3. Count plants / percentage cover / abundance scale (in quadrats)

Accept abundance scale

OR

Count plants and record where they touch line / transect;

3 max

(b) 1. Stabilises sand / stops sand shifting;

2. Forms / improves soil / makes conditions less hostile;

Allow credit for example of making conditions less hostile such as:

Adds nutrients

Improves water retention

2

[5] (a) 1. Breeding less successful;

24

2. Feathers in poor condition;

3. Less energy for breeding / reproduction / stated aspect of reproduction;

1. Reject cannot breed.

2. Ignore "wings damaged".

2 max

(b) (i) 1. Avoids bias / data representative / choice of nest not influencing results;

2. Allows use of statistical tests / named statistical test;

2

(ii) Accept general statements or statements based on data that make the requiredpoints.

1. Correct statement about range of 0 – 15;

2. Correct statement about 0;

3. Correct statement about 170;

4. Correct statement about gap between 15 and 170;

1. e.g. No pattern / no correlation between 0 and 15.

2. e.g. Birds with no feather mites did not have (the) high(est) breeding success / 86%.

3. e.g. Highest number of feather mites linked to lowest breedingsuccess.

4. e.g. No data between 15 and 170.

3 max

(c) (i) There is no correlation between the number of feather mites andbreeding success / the number of feather mites does not affect breeding success;

These specific variables must be stated.

Reject difference between feather mite and breeding success.

1

(ii) Breeding success decreases as feather mites increases / negativecorrelation between feather mites and breeding success; *Accept reproductive or breeding success.*

1

(d) (i) 1. The larger the size of the oil gland the larger the number of feather mites;

2. Positive correlation;

3. (Wide) scatter of points / points not on line;

3. Accept any answer that conveys the idea of a wide spread.

Ignore any reference to anomalies.

2max

(ii) No mark for effect on reliability, marks are for explanation.

1. Oil gland size / number of mites could vary;

2. At different times of the day / due to preening;
Ignore responses that state oil gland affects numbers of mites.
Allow preening affects mite numbers / size of oil gland.

2

(e) 1. Improve health of birds / reduces disease / reduces harm;

2. Healthier birds may find more food for young / do not pass on disease / have greater specified aspect of breeding success;
1. Ignore death of birds.
2. Specified aspect can include longer breeding life.

2

[15] (a) Greater when treated with herbicide **G**;

25

Same number but total biomass larger;
Can be shown by figures

2

(b) Fewer weeds left to produce seeds;
Less contamination of crop (by weeds); / fewer weeds to separate from crop; / less competition (between crop and weeds);

2

(c) **Advantage**
Weeds growing fast / photosynthesising fast so effect will be seen / will have large effect;

Disadvantage
No information about winter / other seasons / weeds not growing fast / could kill (beneficial) insects / crop may be harvested before effects noticeable;
One mark for advantage and one mark for disadvantage

2

(d) **Limitations of investigation**
1. No control / untreated field;

2. Amount of herbicide may be different;
3. May be differences between fields; Eg soil Nutrients / fertiliser added Type of weedMicroclimates
4. May be different number of weeds (at start);

Limitations of results

5. No replicates / one set of data;
6. Field size may vary / not specified;

Scientific Research

7. Scientific research / example of scientific research has led to greater yield;

When marking please number the marking points

e.g. ✓5 *means a mark award for point 5*

5 max

[11] (a) Shows mass of wheat seedlings when grown on their own;

26

Allows percentage to be calculated / allows comparison / allows effect of competition to be seen;

2

(b) 1. Interspecific competition / ryegrass reduces growth of wheat;

2. Justification by using values;

100% with wheat but less when grown with ryegrass

3. Competition between shoots had a greater effect than competition betweenroots;

4. Justification by use of values;

*46% when shoots complete / in **Y** / 76% when roots compete / **X***

When marking please number marking points

E.g. ✓4 *means a mark awarded for point 4.*

4

(c) Growth involves enzymes / enzyme-controlled reactions;

Lower temperature means less kinetic energy / fewer collisions / fewer E–S complexes formed;

Wheat and ryegrass affected to a different extent;

Accept other valid physiological processes such as growth involves diffusion / lower temperature means less kinetic energy / molecules move slower.

2 max

[8]

27

(a) (i) Decrease in spadefoot toad;

Decrease in southern toad up to 4 newts per pond, then increase (at 8 newts per pond);

Allow one mark for answers stating decrease in both toad species

2

(ii) Predators / newts eat / feed / prey on toad (tadpoles);

Less competition more food / resources / fewer toads feeding on frogs;

Allow first mark if reference is made to either toad species being eaten.

For first mark candidate must clearly indicate that the newts are feeding on the toads. Answers simply stating that newts are increasing and toads are decreasing are not sufficient.

2

(b) Fewer toads / tadpoles (as number of predators increases in Figure 1);

More food, so are larger / grow more / increase in mass;

If candidate clearly indicates fewer frog tadpoles survive, negate the first marking point. However, accept decrease in overall number of tadpoles which may include frog tadpoles.

2

[6]

28

(a) Same number of ryegrass seedlings in distilled water;

1

(b) (i) Produce null hypothesis;

Carry out Spearman Rank correlation test / find correlation coefficient;

Use values to show P < critical value / find probability of results being due to chance;

Accept valid example

E.g. There is no correlation between inhibition of germination and the concentration of the extract.

2 max

(ii) May be another factor / named factor (that also inhibits germination);

e.g. amount of water in extract

1

(c) (i) Extract inhibits ryegrass germination / extract stops ryegrass starting to grow;

Inhibition of root length / causes ryegrass to have shorter roots;

2

(ii) Scientists crushed plants to get extract;

Plants might not secrete substances in the extract into the soil;

These substances might get broken down in the soil;

Wheat and ryegrass might not grow at the same time / wheat plants might not produce substance when ryegrass is growing;

Concentration of extract in the soil might be different from that in solution;

3 max

[9] (a) 1. (Colonisation by) pioneer (species);

29

2. Change in environment / example of change caused by organisms present;

3. Enables other species to colonise / survive;

4. Change in diversity / biodiversity;

5. Stability increases / less hostile environment;

6. Climax community;

Example of change e.g. formation of soil / humus / organic matter / increase in nutrients;

Do not accept genetic diversity for mark point 4.

5 max

(b) 1. Geographical isolation;

2. Variation due to mutation;

3. Different environmental / abiotic / biotic conditions / selection pressures;

4. Selection for different / advantageous, features / characteristics / mutation / /allele / differential reproductive success / (selected) organisms survive and reproduce;

5. Leads to change in allele frequency;

In this question must refer to allele where appropriate, not gene.

5

[10] (a) Two marks for correct answer of 59 / 60;;

30

One mark for incorrect answer clearly derived from figures of 18, 28 and 38;

Ignore: any figures after decimal point.

2

(b) (i) Population changes;

Reject: population decreases

As young birds leave nest / join population;

Reject first point if (young) birds are leaving population / migrating

2

(ii) (Would be likely to) catch all birds (again) in second sample / sample sizes are the same;

Neutral: references to breeding

Birds (in territories and) not mixing with population;

Accept: idea of the population is divided

Accept only estimates number of birds in territories sampled / territory sample not representative (of population) for 1 mark

2

(c) (Recording) DNA / base sequence is like marking (animal) / wouldn't need to mark;

(Finding identical / same base sequence) would show animal has been caught / recorded before;

2

[8]

31

(a) (Increase in) dead organisms / humus / decomposition;

Leading to (increase in) nitrification / ammonia to nitrate / activity of nitrifying bacteria;

2

(b) (i) Bare soil temperatures fluctuate;

Reject: environmental temperature
Accept: converse

More bare soil, early / at start of succession / when few plants;

2

(ii) Plant will grow / survive in the shade / when overshadowed (by taller plants) / when receiving less light;

Effect on plant with reason for effect
Ignore reference to competition

1

(c) (Grassland consists of) small / annual plants which will be replaced by / outcompetedby woody plants;

Must be in the context of grassland

Need idea of replaced not just an increase in percentage cover

So these (woody plants) must be removed / have growth checked / grazed;

2

[7]

32

(a) (i) Fewest people at site R as mean is lowest;

Accept use of mean values to show 2.2 is the lowest

Standard deviations do not overlap so significant / not due to chance;

Accept use of values / description of standard deviation even in wording 'standard deviation' is not used

2

(ii) There was a probability of less than 0.05 / 5 in a hundred / 5%;

In the context of less than
Accept converse: probability of more than 95%

That the difference was due to chance;

Look for idea of difference (between sites)

2

(b) (i) (Would not be reliable as) number of species is still increasing;

Accept: has not reached peak / maximum or if shown by values

1

(ii) Idea of curve has flattened / no more species found so no benefit / no point /takes unnecessary time / takes unnecessary effort / can get same results with fewer quadrats; *Basic idea is of minimising effort.*

If values used reward idea rather than accuracy of numbers

1

(c) Combustion / would burn / cause loss of substances (other than water) / namedsubstance / cause loss of dry mass;;

Accept: only want water to be lost

Ignore: reference to decomposition

1

(d) Seaweeds / plants are producers / lower / first trophic level / animals are consumers /higher trophic level / feed on seaweeds;

Accept relevant position in food chain as trophic level

Loss of energy between trophic levels as a result of respiration / as heat;

Accept: energy transfer is inefficient

Accept: description of trophic levels

Accept: not all seaweed / eaten

2

(e) (i) The site / site U with most people / 34.6 has the largest ratio / 3.24;

Accept: as number of people increases, ratio increases

(Large value of ratio due to) large biomass ÷ small number / large size ÷ small number / biomass greater than abundance;

Explanation of seaweed ratio

2

(ii) 1. Fewer larger animals / more smaller animals where more people / moredisturbance; *Principle*

2. 0.09 linked to 34.6 / appropriate link between row 4 and row 1;: *Use of data*

3. Larger animals affected by human activity;*Accept: converse*

4. Smaller animals are young animals;*Accept: converse*

5. Fewer species of seaweed (with disturbance);*Accept if shown by figures*

6. (So) fewer niches / habitats (for large animals);*Accept idea of disturbance / damage to niche / habitat*

4 max

[15] (a) 1. Evidence for red oak is reliable because 100% healthy and large sample size /

evidence for paper birch unreliable because sample size too small;

2. Other species show injury so may not be tolerant;

3. Amount of injury is subjective so not reliable;

4. Paper birch is 100% healthy with high chloride in tissues so may be tolerant;

4

(b) (Resource B suggests that) sodium chloride decreases the percentage germination (of barley);

(Resource C suggests that) sodium chloride decreases the yield of some grasses / named grasses / named crops;

(Resource D suggests that) the damage in susceptible plants / trees is associated with chloride accumulating in the tissues;

Some plants / trees are able to prevent chloride from entering the tissues and are not damaged;

4

[8] Lay tape / rope at right angle / perpendicular to road;

34

Take samples at regular / stated intervals;
Using a quadrat;
Count numbers / percentage cover of dandelions;
Use several transects;

4 max

[4]

(a) Two marks for correct answer, 41.9 / 42 ;;

35

One mark for incorrect answer of 0.42;

2

(b) Increases proportion of crop that is used / greater proportion is grain / reducesproportion of crop that is not used / is not grain;

1

(c) Quadrats from different parts of field;
Biotic / abiotic factors / named biotic / abiotic factor different;

2

(d) Water (in plants and grain);
Varies;

2

[7]